New York ISO

2021-2040 System & Resource Outlook

DRAFT for 7/14 ESPWG

Appendix A: Glossary

Ancillary Services: Services necessary to support the transmission of Energy from Generators to Loads, while maintaining reliable operation of the NYS Power System in accordance with Good Utility Practice and Reliability Rules. Ancillary Services include Scheduling, System Control and Dispatch Service; Reactive Supply and Voltage Support Service (or Voltage Support Service); Regulation Service; Energy Imbalance Service; Operating Reserve Service (including Spinning Reserve, 10-Minute Non-Synchronized Reserves and 30-Minute Reserves); and Black Start Capability. (As defined in the Services Tariff.)

Bid Production Cost: Total cost of the Generators required to meet Load and reliability Constraints based upon Bids corresponding to the usual measures of Generator production cost (*e.g.*, running cost, Minimum Generation Bid, and Start Up Bid). (As defined in the NYISO Tariffs.)

New York State Bulk Power Transmission Facility (BPTF): Facilities identified as the New York State Bulk Power Transmission Facilities in the annual Area Transmission Review submitted to the Northeast Power Coordinating Council by the NYISO pursuant to Northeast Power Coordinating Council requirements. See NYISO OATT

Business Issues Committee (BIC): A NYISO governance committee that is charged with, among other things, the responsibility to establish procedures related to the efficient and non-discriminatory operation of the electricity markets centrally coordinated by the NYISO, including procedures related to Bidding, Settlements and the calculation of market prices. The BIC reviews the System & Resource Outlook report and makes recommendations regarding review of the report by the Management Committee.

Capacity: The capability to generate or transmit electrical power (in MW), or the ability to reduce demand at the direction of the ISO, measured in MW. (As defined in the NYISO Tariffs.)

CARIS: The now expired Congestion Assessment and Resource Integration Study for economic planning developed by the ISO in consultation with the Market Participants and other interested parties pursuant to Section 31.3 of this Attachment Y. (As defined in the NYISO OATT.) The study is replaced by System & Resource Outlook and Economic Transmission Project Evaluation.

Clean Energy Standard (CES): State initiative for 70% of electricity consumed in New York State to be produced from renewable sources by 2030.

Climate Leadership and Community Protection Act (CLCPA): State statute enacted in 2019 to address and mitigate the effects of climate change. Among other requirements, the law mandates that; (i) 70% of energy consumed in New York State be sourced from renewable resources by 2030, (ii) greenhouse gas emissions must be reduced by 40% by 2030, (iii) the electric generation sector must be zero greenhouse gas emissions by 2040, and (iv) greenhouse gas emissions across all sectors of the economy must be reduced by 85% by 2050.

Comprehensive Reliability Plan (CRP): A biennial study undertaken by the NYISO that evaluates projects offered to meet New York's future electric power needs, as identified in the Reliability Needs Assessment (RNA). The CRP may trigger electric utilities to pursue regulated solutions to meet Reliability Needs if market-based solutions will not be available by that point.

Comprehensive System Planning Process (CSPP): The Comprehensive System Planning Process set forth in the NYISO OATT Attachment Y, and in the Interregional Planning Protocol, which covers the reliability planning, economic planning, Public Policy Requirements planning, cost allocation and cost recovery, and interregional planning process (As defined in the OATT.)

Congestion: A characteristic of the transmission system produced by a constraint on the optimum economic operation of the power system, such that the marginal price of Energy to serve the next increment of Load, exclusive of losses, at different locations on the Transmission System is unequal. (As defined in the NYISO Tariffs.)

Congestion Rent: The opportunity costs of transmission Constraints on the NYS Bulk Power Transmission System. Congestion Rents are collected by the NYISO from Loads through its facilitation of LBMP Market Transactions and the collection of Transmission Usage Charges from Bilateral Transactions. (As defined in the OATT.)

Contingency: An actual or potential unexpected failure or outage of a system component, such as a Generator, transmission line, circuit breaker, switch or other electrical element. A Contingency also may include multiple components, which are related by situations leading to simultaneous component outages. (As defined in the NYISO Tariffs.)

Day Ahead Market (DAM): A NYISO-administered wholesale electricity market in which Capacity, Energy, and/or Ancillary Services are scheduled and sold Day-Ahead consisting of the Day-Ahead scheduling process, price calculations, and Settlements. The DAM sets prices as of 11 a.m. the day before the day these products are bought and sold, based on generation and energy transaction bids offered in advance to the NYISO. More than 90% of energy transactions occur in the DAM. (As defined in the NYISO Tariffs)

DC tie-lines: A high voltage transmission line that uses direct current for the bulk transmission of electrical power between two control areas.

Demand Response: A mechanism used to encourage consumers to reduce their electricity use during a specified period, thereby reducing the peak demand for electricity.

Dispatchable Emission Free Resource (DEFR): A proxy generator type assumed for generation expansion in the Policy Case to represent a yet unavailable future technology that would be dispatchable and produces emissions-free energy (*e.g.*, hydrogen, RNG, nuclear, other long-term season storage, etc.).

Eastern Interconnection Planning Collaborative (EIPC): A group of planning authorities convened to establish

processes for aggregating the modeling and regional transmission plans of the entire Eastern Interconnection and for performing inter-regional analyses to identify potential opportunities for efficiencies between regions in serving the needs of electrical customers.

Economic Dispatch of Generation: The operation of generation facilities to produce energy at the lowest cost to reliably serve consumers.

Economic Transmission Project Evaluation (ETPE): The evaluation of a Regulated Transmission Project by the NYISO. Under this process a Developer can propose a RETP to address constraint(s) on the BPTFs identified in the Economic Planning Process for purposes of potential cost allocation and cost recovery. The process is further described in Sections 31.3.2, 31.5.1, 31.5.4, and 31.5.6 (As defined in the OATT.)

Electric System Planning Working Group (ESPWG): A NYISO governance working group for Market Participants designated to fulfill the planning functions assigned to it. The ESPWG is a working group that provides a forum for stakeholders and Market Participants to provide input into the NYISO's CSPP, the NYISO's response to FERC reliability-related Orders and other directives, other system planning activities, policies regarding cost allocation and recovery for reliability projects, and related matters.

Exports: A Bilateral Transaction or purchases from the LBMP Market where the Energy is delivered to a NYCA Interconnection with another Control Area. (As defined in the NYISO Tariffs.)

External Areas: Neighboring Control Areas including Hydro Quebec, ISO-New England, PJM Interconnection, and IESO.

Federal Energy Regulatory Commission (FERC): The federal energy regulatory agency within the U.S. Department of Energy that approves the NYISO's tariffs and regulates its operation of the bulk electricity grid, wholesale power markets, and planning and interconnection processes.

FERC Form 715: An annual transmission planning and evaluation report required by the FERC – filed by the NYISO on behalf of the transmitting utilities in New York State.

FERC Order No. 890: Adopted by FERC in February 2007, Order 890 is a change to FERC's 1996 open access regulations (established in Orders 888 and 889). Order 890 added provisions establishing competition in transmission planning, transparency and planning in wholesale electricity markets and transmission grid operations, and strengthened the OATT with regard to non-discriminatory transmission service. Order 890 requires Transmission Providers – including the NYISO – to have a formal planning process that provides for a coordinated transmission planning process, including reliability and economic planning studies.

Gold Book: Annual NYISO publication, also known as the Load and Capacity Data Report. See Library/Reports at NYISO.com

Heat Rate: A measurement used to calculate how efficiently a generator uses thermal energy. It is expressed as the number of BTUs of thermal energy required to produce a kilowatt-hour of electric energy. Operators of generating facilities can make reasonably accurate estimates of the amount of heat energy a given quantity of any type of fuel. When thermal energy input is compared to the actual electric energy produced by the generator, the resulting figure tells how efficiently the generator converts fuel into electrical energy.

High Voltage Direct Current (HVDC): A transmission line that uses direct current for the bulk transmission of electrical power, in contrast with the more common alternating current systems. For long-distance distribution, HVDC systems are less expensive and suffer lower electrical losses.

Hurdle Rate: The conditions in which economic interchange is transacted between neighboring markets/control areas. The rate represents a minimum savings level, in $/MWh, that needs to be achieved before energy will flow across the interface.

Imports: A Bilateral Transaction or sale to the LBMP Market where Energy is delivered to a NYCA Interconnection from another Control Area. (As defined in the NYISO Tariffs.)

Independent System Operator (ISO): An organization, formed at the direction or recommendation of the Federal Energy Regulatory Commission (FERC), which coordinates, controls and monitors the operation of the electrical power system, usually within a single U.S. State, but sometimes encompassing multiple states.

Installed Capacity (ICAP): A generator or load facility that complies with the requirements in the Reliability Rules and is capable of supplying and/or reducing the demand for energy in the NYCA for the purpose of ensuring that sufficient energy and capacity are available to meet the Reliability Rules. (As defined in the OATT.)

Installed Reserve Margin (IRM): The amount of installed electric generation capacity above 100% of the forecasted peak electric consumption that is required to meet the NYSRC resource adequacy criteria. Most planners consider a 15-20% reserve margin essential for good reliability.

ISO Market Administration and Control Area Services Tariff (Services Tariff): Sets forth the provisions applicable to the services provided by the ISO related to its administration of competitive markets for the sale and purchase of Energy and Capacity and for the payments to Suppliers who provide Ancillary Services to the ISO in the ISO Administered Markets ("Market Services") and the ISO's provision of Control Area Services ("Control Area Services"), including services related to ensuring the reliable operation of the NYS Power System. (As defined in the Services Tariff.)

ISO Open Access Transmission Tariff (OATT): Every [FERC]-approved ISO or RTO must have on file with [FERC] an open access transmission tariff of general applicability for transmission services, including ancillary services, over such facilities. (As defined in the Code of Federal Regulations.)

Load: A term that refers to either a consumer of Energy or the amount of demand (MW) or Energy (MWh) consumed by certain consumers. (As defined in the NYISO Tariffs.)

Locational Capacity Requirement (LCR): Specifies the

minimum amount of installed capacity that must be procured from resources situated specifically within a locality (Zones G-J, Zone J, and Zone K). It considers resources within the locality as well as the transmission import capability to the locality in order to meet the resource adequacy reliability criteria of the NYSRC and the NPCC.

Load Serving Entity (LSE): Any entity, including a municipal electric system and an electric cooperative, authorized or required by law, regulatory authorization or requirement, agreement, or contractual obligation to supply Energy, Capacity and/or Ancillary Services to retail customers located within the NYCA, including an entity that takes service directly from the NYISO to supply its own Load in the NYCA. (As defined in the Services Tariff.)

Load Zones: The eleven regions in the NYCA connected to each other by identified transmission interfaces. Designated as Load Zones A-K.

Local Transmission Planning Process (LTPP): The first step in the CSPP, under which stakeholders in New York's electricity markets participate in local transmission planning.

Locational Based Marginal Pricing (LBMP): The price of Energy at each location in the NYS Transmission System.

Management Committee: NYISO governance committee that reviews the System & Resource Outlook report following review by the Business Issues Committee and makes recommendations regarding approval to the NYISO's Board of Directors.

Multi-Area Production Simulation (MAPS) Software: An analytic tool for market simulation and asset performance evaluations.

Multi-Area Reliability Simulation (MARS) Software: An analytic tool for market simulation to assess the reliability of a generation system comprised of any number of interconnected areas.

Market Based Solution: Investor-proposed projects that are driven by market needs to meet future reliability requirements of the bulk electricity grid as outlined in the RNA. Those solutions can include generation, transmission and Demand Response programs. .

Market Participant: An entity, excluding the NYISO, that produces, transmits sells, and/or purchases for resale capacity, energy and ancillary services in the wholesale market. Market Participants include: customers under the NYISO tariffs, power exchanges, TOs, primary holders, load serving entities, generating companies and other suppliers, and entities buying or selling transmission congestion contracts.

New York Control Area (NYCA): The area under the electrical control of the NYISO. It includes the entire state of New York and is divided into 11 Load Zones.

New York State Department of Public Service (NYDPS): The New York State agency that supports the New York State Public Service Commission. See DPS.NY.gov

New York State Energy Research and Development Authority (NYSERDA): The New York State public authority charged with conducting a multifaceted energy and environmental research and development program to meet New York State's diverse economic needs, including administering the state System Benefits Charge, Renewable Portfolio Standard, energy efficiency programs, the Clean Energy Fund, and the NY-Sun Initiative. See NYSERDA.NY.gov

New York Independent System Operator (NYISO): Formed in 1997 and commencing operations in 1999, the NYISO is a not-for-profit organization that manages New York's bulk electricity grid – a more than 11,000-mile network of high voltage lines that carry electricity throughout the state. The NYISO also oversees the state's wholesale electricity markets. The organization is governed by an independent Board of Directors and a governance structure made up of committees with Market Participants and stakeholders as members.

New York State Public Service Commission (NYSPSC): The decision-making body of the New York State Department of Public Service, which regulates the state's electric, gas, team, telecommunications, and water utilities, oversees the cable industry, has the responsibility for setting rates and overseeing that safe and adequate service is provided by New York's utilities, and exercises jurisdiction over the siting of major gas and electric transmission facilities.

New York State Reliability Council (NYSRC): A not-for-profit entity the mission of which is to promote and preserve the reliability of electric service on the New York State Power System by developing, maintaining, and, from time-to-time, updating the Reliability Rules which shall be complied with by the New York Independent System Operator (NYISO) and all entities engaging in electric transmission, ancillary services, energy and power transactions on the New York State Power System.

New York State Bulk Power Transmission Facilities (BPTFs): The facilities identified as the New York State Bulk Power Transmission Facilities in the annual Area Transmission Review submitted to the NPCC by the ISO pursuant to NPCC requirements. (As defined in the OATT.) The BPTFs include (i) all NYCA transmission facilities 230 kV and above, (ii) all NYCA facilities identified by the NYISO to be part of the Bulk Power System, as defined by the NPCC and the NYSRC, and (iii) select 115 kV and 138 kV facilities that are considered to be bulk power transmission in accordance with the 2004 FERC Order.

Nomogram: Nomograms are system representations used to model electrical relationships between system elements. These can include; voltage or stability related to load level or generator status; two interfaces related to each other; generating units the output of which are related to each other; and operating procedures.

North American Electric Reliability Corporation (NERC): A nonprofit corporation based in Atlanta Georgia to promote the reliability and adequacy of bulk power transmission in the electric utility systems of North America. NERC establishes mandatory reliability standards that it enforces and that are enforced by the Northeast Power Coordinating Council.

Northeast Coordinated System Planning Protocol (NCSPP): ISO New England, PJM and the NYISO work together under the NCSPP, to analyze cross-border issues and produce a regional electric reliability plan for the northeastern United States.

Northeast Power Coordinating Council (NPCC): A not-for-profit corporation in the state of New York responsible for promoting and enhancing the reliability of the international, interconnected bulk power system in Northeastern North America. The NPCC encompasses Ontario, Quebec, New York and New England, and serves as the Regional Entity overseeing and enforcing the reliability standards of the North American Electric Reliability Corporation.

Operating Reserves: Capacity that is available to supply Energy or reduce demand and that meets the requirements of the NYISO. (As defined in the Services Tariff.)

Overnight Costs: Direct permitting, engineering and construction costs with no allowances for financing costs.

Phase Angle Regulator (PAR): Device that controls the flow of electric power in order to increase the efficiency of the transmission system.

PLEXOS Software: An analytic tool used for purposes of capacity expansion optimization in this study.

Proxy Generator Bus: A proxy bus located outside the NYCA that is selected by the NYISO to represent a typical bus in an adjacent Control Area and for which LBMP prices are calculated. The NYISO may establish more than one Proxy Generator Bus at a particular Interface with a neighboring Control Area to enable the NYISO to distinguish the bidding, treatment and pricing of products and services at the Interface. (As defined in the NYISO Tariffs.)

Public Policy Transmission Planning Process (PPTPP): The process by which the ISO solicits needs for transmission driven by Public Policy Requirements, evaluates all solutions on a comparable basis, and selects the more efficient or cost effective transmission solution, if any, for eligibility for cost allocation under the ISO Tariffs. (As defined in the OATT.)

Queue Position: The order, in the NYISO's Interconnection Queue, of a valid Interconnection Request, Study Request, or Transmission Interconnection Application relative to all other pending Requests. See NYISO OATT

Regional Greenhouse Gas Initiative (RGGI): A cooperative effort by ten Northeast and Mid-Atlantic states to limit carbon dioxide emissions using a market-based cap-and-trade approach.

Regulated Backstop Solution: Proposals required of Responsible TOs to meet Reliability Needs identified in the RNA as outlined in the OATT. Those solutions can include generation, transmission or Demand Response. Non-Transmission Owner developers may also submit regulated solutions. The NYISO may call for a Gap Solution if neither market-based nor regulated backstop solutions meet Reliability Needs in a timely manner. To the extent possible, the Gap Solution should be temporary and strive to be compatible with market-based solutions. The NYISO is responsible for evaluating all solutions to determine if they will meet identified Reliability Needs in a timely manner.

Regulated Economic Transmission Project (RETP): A transmission project or a portfolio of transmission projects proposed by Developer(s) to address constraint(s) on the BPTFs identified in the Economic Planning Process, which transmission project(s) are evaluated in the Economic Transmission Project Evaluation and are eligible for cost allocation and cost recovery under the ISO OATT if approved by a vote of the project's Load Serving Entity beneficiaries pursuant to Section 31.5.4 of this Attachment Y.

Regulation Service: The Ancillary Service defined by the FERC as "frequency regulation" and that is instructed as Regulation Capacity in the Day-Ahead Market and as Regulation Capacity and Regulation Movement in the Real-Time Market.

Reliability Need: A condition identified by the NYISO in the RNA as a violation or potential violation of Reliability Criteria. (As defined in the OATT.)

Reliability Needs Assessment (RNA): A biennial report that evaluates resource adequacy and transmission system security over years three through ten of a ten-year planning horizon, and that identifies future needs of the New York electric grid. It is the first step in the NYISO's Reliability Planning Process.

Reliability Planning Process (RPP): The process set forth in this [OATT] Attachment Y by which the ISO determines in the RNA whether any Reliability Need(s) on the BPTFs will arise in the Study Period and addresses any identified Reliability Need(s) in the CRP, as the process is further described in Section 31.1.2.2. (As defined in the OATT.)

Requested Economic Planning Study (REPS): The process by which a Market Participant or any other interested party may, at any time, request that the NYISO perform a study separate from and in addition to the System & Resource Outlook at the requesting party's sole expense and solely for informational purposes. The process is further described in Section 31.3.3. (As defined in the OATT.)

Security Constrained Unit Commitment (SCUC): A process developed by the NYISO, which uses a computer algorithm to dispatch sufficient resources, at the lowest possible Bid Production Cost, to maintain safe and reliable operation of the NYS Power System.

Shadow Price: The incremental economic impact of a constraint on system production cost. Calculated in linear program optimization for economic dispatch.

Short-Term Assessment of Reliability (STAR): The NYISO's quarterly assessment, in coordination with the Responsible Transmission Owner(s), of whether a Short-Term Reliability Process Need will result from a generator be coming retired, entering into a Mothball Outage, or being unavailable due to an Installed Capacity Ineligible Forced Outage, or from other changes to the availability of Resources or to the New York State Transmission System. See NYISO OATT Attachment FF

Short-Term Reliability Process: The process by which the NYISO evaluates and addresses the reliability impacts resulting from both: (1) Generator Deactivation

Reliability Need(s), and/or (2) other Reliability Needs on or affecting the Bulk Power Transmission Facilities that are identified in a Short-Term Assessment of Reliability. The Short-Term Reliability Process evaluates reliability needs in years one through five of the ten-year Study Period, with a focus on needs in years one through three. See NYISO OATT Attachment FF

Special Case Resource (SCR): Demand Side Resources whose Load is capable of being interrupted upon demand at the direction of the ISO, and/or Demand Side Resources that have a Local Generator, which is not visible to the ISO's Market Information System and is rated 100 kW or higher, that can be operated to reduce Load from the NYS Transmission System or the distribution system at the direction of the ISO. (As defined in the Services Tariff.)

Stakeholders: A person or group that has an investment or interest in the functionality of New York's transmission grid and markets.

System & Resource Outlook (formerly "CARIS"): Biennial report produced by the NYISO, through which it summarizes the current assessments, evaluations, and plans in the biennial Comprehensive System Planning Process, produces a twenty-year projection of congestion on the New York State Transmission System, identifies, ranks, and groups congested elements, and assesses the potential benefits of addressing the identified congestion.

Thermal transfer limit: The maximum amount of heat a transmission line can withstand. The maximum reliable capacity of each line, due to system stability considerations, may be less than the physical or thermal limit of the line.

Transfer Capability: The amount of electricity that can flow on a transmission line at any given instant, in MW, respecting facility rating and reliability rules.

Transmission Congestion Contract (TCC): The right to collect, or obligation to pay, Congestion Rents in the Day Ahead Market for Energy associated with a single MW of transmission between a specified Point Of Injection and Point Of Withdrawal. TCCs are financial instruments that enable Energy buyers and sellers to hedge fluctuations in the price of transmission. (As defined in the OATT.)

Transmission Constraint: Limitations on the ability of a transmission facility to transfer electricity during normal or emergency system conditions.

Transmission District: The geographic area in which a Transmission Owner, including LIPA, is obligated to serve Load, as well as the customers directly interconnected with the transmission facilities of the Power Authority of the State of New York. (As defined in the NYISO Tariffs.)

Transmission Interface: A defined set of transmission facilities that separate Load Zones and that separate the NYCA from adjacent Control Areas.

Transmission Owner (TO): The public utility or authority (or its designated agent) that owns facilities used for the transmission of Energy in interstate commerce and provides Transmission Service under the Tariff. (As defined in the NYISO Tariffs.)

Transmission Planning Advisory Subcommittee (TPAS): A group of Market Participants that advises the NYISO Operating Committee and provides support to the NYISO Staff with regard to transmission planning matters including transmission system reliability, expansion, and interconnection.

Unforced Capacity (UCAP): The measure by which Installed Capacity Suppliers will be rated, in accordance with formulae set forth in the ISO Procedures, to quantify the extent of their contribution to satisfy the NYCA Installed Capacity Requirement, and which will be used to measure the portion of that NYCA Installed Capacity Requirement for which each LSE is responsible.

List of Key Acronyms

100x40	New York 100% Carbon Free Electric Sector by 2040 Goal
70x30	New York 70% End Use Renewable Energy by 2030 Goal
BTM-PV	Behind-The-Meter Photovoltaic Generation
CARIS	Congestion Assessment and Resource Integration Study
CC	Combined Cycle Generation
CLCPA	Climate Leadership and Community Protection Act
CO_2	Carbon Dioxide
CT	Combustion Turbine
DEFR	Dispatchable Emission Free Resource
DMNC	Dependable Maximum Net Capacity
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
ESPWG	Electric System Planning Working Group
ESR	Energy Storage Resource
ETPE	Economic Transmission Project Evaluation
FERC	Federal Energy Regulatory Commission
Gold Book	NYISO's Load and Capacity Data Report "Gold Book"
HRM	Hourly Resource Modifier
HQ	Hydro Quebec
ICAP	Installed Capacity
LBMP	Locational-Based Marginal Pricing
LBW	Land Based Wind
MAPS	Multi Area Production Simulation Software
MARS	Multi-Area Reliability Simulation software
MW	Megawatt
MWh	Megawatt Hour
NOx	Nitrogen Oxide
NREL	National Renewable Energy Laboratory

NYCA	New York Control Area
NYISO	New York Independent System Operator
NYSDPS	New York State Department of Public Service
NYSERDA	New York State Energy Research & Development Authority
OATT	Open Access Transmission Tariff
OSW	Offshore Wind
PV	Photovoltaic or Solar Powered Generation
PSH	Pumped Storage Hydro Generation
RE	Renewable Energy
REC	Renewable Energy Certificates
REPS	Requested Economic Planning Study
RETP	Regulated Economic Transmission Project
RGGI	Regional Greenhouse Gas Initiative
RPP	Reliability Planning Process
TARA	Transmission Adequacy & Reliability Assessment
TCCs	Transmission Congestion Contracts
TPAS	Transmission Planning Advisory Subcommittee
TWh	Terawatt Hour
UCAP	Unforced Capacity
UPNY-SENY	Upstate New York – Southeast New York
UPV	Utility Scale Photovoltaic Solar Generation

Appendix B: Other Economic Planning Studies

In addition to the System & Resource Outlook, the Economic Planning Process allows stakeholders to request two types of studies. The Requested Economic Planning Study ("REPS") and Economic Transmission Project Evaluation ("ETPE") provide mechanisms for stakeholders to leverage NYISO models and expertise to study projects and system conditions that differ from the Outlook study. A REPS is an informational study that can be performed in a confidential manner, while an ETPE is performed publicly to evaluate a specific transmission project proposal seeking cost allocation and cost recovery through the NYISO's tariffs. More details on each study type can be found below.

Requested Economic Planning Study ("REPS")

A Market Participant or any other interested party may, at any time, request that the NYISO perform a study separate from and in addition to the System & Resource Outlook at the requesting party's sole expense and solely for informational purposes. The scope and deliverables for the Requested Economic Planning Study will be agreed upon by the NYISO and the requesting party. The rules governing Requested Economic Planning Studies are established in Section 31.3.3 in Attachment Y to the Open Access Transmission Tariff (OATT). The Requested Economic Planning Study Request Form and the Study Agreement for a Requested Economic Planning Study are located in Sections 31.13 and 31.14 in Attachment Y of the OATT. Additionally, the Requested Economic Planning Study Request Form is posted on the NYISO website[1].

Economic Transmission Project Evaluation ("ETPE")

The purpose of the ETPE is to process specific transmission projects for which Developers are seeking to allocate and recover their projects cost through the NYISO OATT as Regulated Economic Transmission Projects. If a Developer voluntarily proposes a RETP to address constraint(s) on the BPTFs identified in the Economic Planning Process, the NYISO: (i) processes that project proposal in an Economic Transmission Project Evaluation in accordance with the relevant provisions set forth in Sections 31.3.2, 31.5.1, 31.5.4, and 31.5.6 of Attachment Y of the NYISO OATT and the Economic Planning Manual and (ii) provides benefit/cost analysis and other analysis of potential generic solutions to the congestion

[1] See under *Economic Planning Studies > Study Forms* which is located on the NYISO Comprehensive System Planning Process webpage (https://www.nyiso.com/cspp/).

identified. For purposes of the ETPE, the NYISO will use the most recent System & Resource Outlook database and report approved by the NYISO Board of Directors.

To perform the ETPE, the NYISO updates the base case database to be utilized in the production cost modeling and associated evaluation of any proposed Regulated Economic Transmission Projects. The tariff establishes the requirements by which the NYISO will first determine whether a proposed Regulated Economic Transmission Project is eligible for consideration by beneficiaries for cost allocation and recovery under the NYISO OATT. In essence, an Economic Transmission Project is eligible for cost allocation if it costs at least $25 million, the benefit to cost ratio of the project is at least 1.0, and 80 percent or more of the weighted vote of the load serving entities approve the project. The tariff also establishes the requirements for the determination of the load serving entity beneficiaries, the assignment of voting shares to load serving entities, and the procedures by which the beneficiaries vote on whether to approve a proposed Regulated Economic Transmission Project for cost allocation and cost recovery under the NYISO OATT. For an Interregional Transmission Project, the NYISO will jointly evaluate the project proposal with the relevant adjacent transmission planning region(s) in accordance with Section 7.3 of the Interregional Planning Protocol.

More details can be found in the Economic Planning Process Manual[2].

[2] Economic Planning Process Manual: https://www.nyiso.com/documents/20142/2924447/epp_caris_mnl.pdf/6510ece7-e0a6-7bee-e776-694abf264bae/

Appendix C: Production Cost Assumptions Matrix

Parameter	Reference Case Model		
	Baseline Case	Contract Case	Policy Case
NYCA System Model			
Assumption Lock Down Date	11/1/2021	12/1/2021	4/1/2022
Peak Load	Based on 2021 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Non-Coincident Peak Demand, including impacts of statewide Energy Efficiency programs.	Based on 2021 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Non-Coincident Peak Demand, including impacts of statewide Energy Efficiency programs.	Peak load forecast consistent with scenario S1 and S2 capacity expansion load forecast model.
Energy Forecast	Energy Forecast based on 2021 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Annual Energy, including impacts of statewide Energy Efficiency programs.	Energy Forecast based on 2021 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Annual Energy, including impacts of statewide Energy Efficiency programs.	Energy forecast consistent with scenario S1 and S2 capacity expansion load forecast model.
Capacity Expansion Load Shape Model	2002 Load Shape	2002 Load Shape	2002 Load Shape and additional modifications for public policy impacts.
Load Uncertainty Model	Only base level forecast utilized; the impact of energy or peak forecasts may be utilized in scenarios.	Only base level forecast utilized; the impact of energy or peak forecasts may be utilized in scenarios.	Only base level forecast utilized; the impact of energy or peak forecasts may be utilized in scenarios.
Generating Unit Capacities	Updated to reflect 2021 Gold Book winter and summer DMNC values.	Updated to reflect 2021 Gold Book winter and summer DMNC values.	Updated to reflect 2021 Gold Book winter and summer DMNC values.

New Resources	Updated as per 2021 Gold Book. (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.2 and NYISO procedures)	Updated as per 2021 Gold Book. (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.2 and NYISO procedures) Generation projects with financial contracts, including state sponsored programs, included	Updated as per 2021 Gold Book. (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.2 and NYISO procedures) Generation projects with financial contracts, including state sponsored programs, included Generation resources to support achievement of state and potential federal policies included per capacity expansion model and consistent with capacity expansion scenario S1 and S2 results
Wind Resource Modeling	Units and capacities updated as per 2021 Gold Book. Existing wind resources are modeled based on unit capacities and actual 2019 shapes. New units modeled based on proximate existing units.	Units and capacities updated as per 2021 Gold Book. Existing wind resources are modeled based on unit capacities and actual 2019 shapes. New units modeled based on proximate existing units or using calculated shapes.	Units and capacities updated as per 2021 Gold Book. Existing wind resources are modeled based on unit capacities and actual 2019 shapes. New units modeled based on proximate existing units or using calculated shapes. For capacity expansion wind resources, zonal to nodal placements done on buses from Interconnection Queue. Resource shapes were obtained based on NREL simulated data at the zonal level.
Solar Resource Modeling	Units and capacities updated as per 2021 Gold Book. Existing solar resources are modeled based on unit capacities and actual 2019 shapes. New units modeled based on proximate existing units.	Units and capacities updated as per 2021 Gold Book. Existing solar resources are modeled based on unit capacities and actual 2019 shapes. New units modeled based on proximate existing units or using calculated shapes.	For capacity expansion solar resources, zonal to nodal placements added based on buses from Interconnection Queue. Resource shapes were obtained based on NREL simulated data at the zonal level.
Offshore Wind Resource Modeling	n/a	The hourly shapes for OSW generators are based on NREL data; contracted projects are based on clustered site level data and candidates for generation expansion are based on zonal data.	The hourly shapes for OSW generators are based on NREL data; contracted projects are based on clustered site level data and candidates for generation expansion are based on zonal data.

Non-NYPA Hydro Capacity Modeling	Updated as per 2021 Gold Book; unit output is modeled consistent with historic levels.	Updated as per 2021 Gold Book; unit output is modeled consistent with historic levels.	Updated as per 2021 Gold Book; unit output is modeled consistent with historic levels.
Special Case Resources	Not utilized in MAPS production cost modeling; may be incorporated in ICAP Metric calculation.	Not utilized in MAPS production cost modeling; may be incorporated in ICAP Metric calculation.	Not utilized in MAPS production cost modeling; may be incorporated in ICAP Metric calculation.
EDRP Resources	N/A for production cost modeling.	N/A for production cost modeling.	N/A for production cost modeling.
External Capacity – Purchases and Wheel-Through	Flows across schedulable and non-schedulable transmission lines are based on economics.	Flows across schedulable and non-schedulable transmission lines are based on economics.	Flows across schedulable and non-schedulable transmission lines are based on economics.
Facility Deactivation and Retirements	Updated as per 2021 Gold Book. (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.2 and NYISO procedures)	Updated as per 2021 Gold Book.. (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.2 and NYISO procedures)	Updated as per 2021 Gold Book (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.2 and NYISO procedures) S1- Deactivations as per capacity expansion scenario S1 outputs S2- Deactivations as per capacity expansion scenario S2 outputs, age-based fossil retirements for applicable units assumed per Climate Action Council Appendix D (ST at 62 years and GT at 47 years of age)
Generator Outages	Scheduled to levelize reserves, as per the maintenance schedules in long term adequacy studies.	Scheduled to levelize reserves, as per the maintenance schedules in long term adequacy studies.	Scheduled to levelize reserves, as per the maintenance schedules in long term adequacy studies.
Gas Turbines Ambient Derate	Modeling utilizes summer and winter DMNC ratings for all units.	Modeling utilizes summer and winter DMNC ratings for all units.	Modeling utilizes summer and winter DMNC ratings for all units.

Environmental Modeling and Emission Allowance Price Forecasts	Allowance costs based on projected RGGI costs and New York Department of Environmental Conservation guidance. SO_2 and NOx Allowance Prices reflect CSAPR markets.	Allowance costs based on projected RGGI costs and New York Department of Environmental Conservation guidance. SO_2 and NOx Allowance Prices reflect CSAPR markets.	Allowance costs based on projected RGGI costs and New York Department of Environmental Conservation guidance. SO_2 and NOx Allowance Prices reflect CSAPR markets. Additional policy-based environmental programs may be modeled.
Commitment and Dispatch Options **Operating Reserves**	Each Balancing Authority commits separately. Hurdle Rates are employed for commitment and dispatch. Operating Reserves as per NYCA requirements.	Each Balancing Authority commits separately. Hurdle Rates are employed for commitment and dispatch. Operating Reserves as per NYCA requirements.	Each Balancing Authority commits separately. Hurdle Rates are employed for commitment and dispatch. Operating Reserves as per NYCA requirements.
Fuel Price Forecast	Annual base prices updated to more heavily weight recent trends. Seasonality and spikes based on five-year history (2016-2020). Calculated natural price forecasts based on blends of hub price forecasts for four hubs (A-E, F-I, J and K). Utilized unit capacities and reported pricing hubs to weight price forecasts. Fuel oil and coal price forecasts are developed utilizing the EIA's annual forecast of national delivered prices. Regional bases are derived using EIA Form 923 data.	Annual base prices updated to more heavily weight recent trends. Seasonality and spikes based on five-year history (2016-2020). Calculated natural price forecasts based on blends of hub price forecasts for four hubs (A-E, F-I, J and K). Utilized unit capacities and reported pricing hubs to weight price forecasts. Fuel oil and coal price forecasts are developed utilizing the EIA's annual forecast of national delivered prices. Regional bases are derived using EIA Form 923 data. .	Annual base prices updated to more heavily weight recent trends. Seasonality and spikes based on five-year history (2016-2020). Calculated natural price forecasts based on blends of hub price forecasts for four hubs (A-E, F-I, J and K). Utilized unit capacities and reported pricing hubs to weight price forecasts. Fuel oil and coal price forecasts are developed utilizing the EIA's annual forecast of national delivered prices. Regional bases are derived using EIA Form 923 data.

Cost Curve Development (including heat rates and emission rates)	Unit heat rates (and emission rates) developed from vendor supplied data, USEPA CAMD fuel input and emissions data matched with NYISO production data for NYCA and USEIA production data for non NYCA units.	Unit heat rates (and emission rates) developed from vendor supplied data, USEPA CAMD fuel input and emissions data matched with NYISO production data for NYCA and USEIA production data for non NYCA units.	Unit heat rates (and emission rates) developed from vendor supplied data, USEPA CAMD fuel input and emissions data matched with NYISO production data for NYCA and USEIA production data for non NYCA units. New technology heat and emission rates developed based upon vendor or publicly available data.
Local Reliability Rules	List and develop appropriate nomograms. Fuel burn restrictions, operating restrictions and exceptions, commitment/dispatch limits.	List and develop appropriate nomograms. Fuel burn restrictions, operating restrictions and exceptions, commitment/dispatch limits.	List and develop appropriate nomograms. Fuel burn restrictions, operating restrictions and exceptions, commitment/dispatch limits. Must-run generation requirements were not replaced as affected generators were retired.
Energy Storage **Gilboa PSH** **Lewiston PSH**	Battery energy storage resources dispatched optimally using zonal load on a daily basis. Gilboa and Lewiston scheduled against NYCA load profile.	Battery energy storage resources dispatched optimally using zonal net load on a daily basis. Gilboa and Lewiston scheduled against NYCA load profile.	Battery energy storage resources dispatched optimally using zonal net load on a daily basis. Gilboa and Lewiston scheduled against NYCA load profile. For capacity expansion storage resources, capacity is based on results from capacity expansion S1 and S2. The resources are dispatched optimally against upstate and downstate zonal load profiles depending on where the resources are located.

Renewable Energy Certificates (REC) Bid Modelling	Existing and contracted land-based wind, offshore wind, and solar projects per NYSERDA large scale renewables database specified REC contract price. Index RECs adjusted by premium to equivalent fixed REC.	Existing and contracted land-based wind, offshore wind, and solar projects per NYSERDA large scale renewables database specified REC contract price. Index RECs adjusted by premium to equivalent fixed REC.	Existing and contracted land-based wind, offshore wind, and solar projects per NYSERDA large scale renewables database specified REC contract price. Index RECs adjusted by premium to equivalent fixed REC. Capacity expansion units: Solar - $20/MWh Land Based Wind - $22/MWh Offshore Wind - $49/MWh
Transmission System Model			
Power Flow Cases	As per RPP or STRP.	As per RPP or STRP	As per RPP or STRP

Interface Limits **Monitored - Contingency Pairs** **Nomograms** **Joint, Grouping** **Unit Sensitive Voltage**	Internal NYCA line, interface and contingency limits updated consistent with Reliability Planning Process and market and grid operation practices. Contingency pairs are expanded to include monitored constraints and contingency pairs either observed in historical market operation or identified in planning and operation studies. Coordinate with the Transmission Owners to incorporate the Transmission Owners' Local Transmission Owner Plans and model the non-BPTF portion of the New York State Transmission System. Interface voltage limits modeled as per latest Benchmark model. Data from the results of external planning studies, vendor-supplied data, operational voltage studies, operational limits, transfer limit analysis for critical interfaces utilized to update transmission model for external regions as required.	Internal NYCA line, interface and contingency limits updated consistent with Reliability Planning Process and market and grid operation practices. Contingency pairs are expanded to include monitored constraints and contingency pairs either observed in historical market operation or identified in planning and operation studies. Coordinate with the Transmission Owners to incorporate the Transmission Owners' Local Transmission Owner Plans and model the non-BPTF portion of the New York State Transmission System. Data from the results of external planning studies, vendor-supplied data, operational voltage studies, operational limits, transfer limit analysis for critical interfaces utilized to update transmission model for external regions as required. Contracted resources and transmission impact captured.	Internal NYCA line, interface and contingency limits updated consistent with Reliability Planning Process and market and grid operation practices. Contingency pairs are expanded to include monitored constraints and contingency pairs either observed in historical market operation or identified in planning and operation studies. Coordinate with the Transmission Owners to incorporate the Transmission Owners' Local Transmission Owner Plans and model the non-BPTF portion of the New York State Transmission System. Data from the results of external planning studies, vendor-supplied data, operational voltage studies, operational limits, transfer limit analysis for critical interfaces utilized to update transmission model for external regions as required. Impacts captured from resources and transmission under contracts as well as driven by policy.

New Transmission Capability	Updated as per 2021 Gold Book and latest Reliability Planning Process. (Application of Baseline Case inclusion rules)	Updated as per 2021 Gold Book. (Application of Baseline Case inclusion rules)	Updated as per 2021 Gold Book. (Application of Baseline Case inclusion rules) New policy-based transmission projects included: NYPA Northern New York Priority Transmission Project (-0MW, +1000MW on Moses South Interface) in 2025 Champlain Hudson Power Express (-0MW, 1250MW) – modeled as fixed profile in Zone J in 2025 Clean Path New York Clean Path New York HVDC (-0MW, +1300MW) in 2027
Internal Controllable Lines (PARs, HVDC, VFT)	Optimized in simulation consistent with operating protocols and agreements, as appropriate.	Optimized in simulation consistent with operating protocols and agreements, as appropriate.	Optimized in simulation consistent with operating protocols and agreements, as appropriate.
External System Model			
External Area Models **Fuel Forecast**	Power flow data from RPP and/or STRP, "production" data developed by NYISO with vendor and neighbor input. Linked with NYCA forecast.	Power flow data from RPP and/or STRP, "production" data developed by NYISO with vendor and neighbor input. Linked with NYCA forecast.	Power flow data from RPP and/or STRP, "production" data developed by NYISO with vendor and neighbor input. Linked with NYCA forecast.
External Capacity **Demand Forecast**	Neighboring systems updated in August 2021. PJM generation fleet updated based on PJM New Services Queue. ISO-NE generation fleet updated based on CELT filings. IESO generation fleet based on publicly available reports.	Neighboring systems updated in August 2021. PJM generation fleet updated based on PJM New Services Queue. ISO-NE generation fleet updated based on CELT filings. IESO generation fleet based on publicly available reports.	Neighboring systems updated in August 2021. PJM generation fleet updated based on PJM New Services Queue. ISO-NE generation fleet updated based on CELT filings. IESO generation fleet based on publicly available reports.

System Representation	HQ modeled as fixed hourly schedule, synchronized with all other external injections. Full Representation/Participation: NYISO ISONE IESO PJM Classic & AP, AEP, CE, DLCO, DAY, VP, EKPC Proxy Bus Injection: HQ-NYISO, HQ-NE-ISO, NB-NEISO, HQ – IESO Transmission Only/Zeroed Out: MECS, FE, SPP, MAR, NIPS, OVEC, TVA, FRCC, SERC, ERCOT, WECC	HQ modeled as fixed hourly schedule, synchronized with all other external injections. Full Representation/Participation: NYISO ISONE IESO PJM Classic & AP, AEP, CE, DLCO, DAY, VP, EKPC Proxy Bus Injection: HQ-NYISO, HQ-NE-ISO, NB-NEISO, HQ – IESO Transmission Only/Zeroed Out: MECS, FE, SPP, MAR, NIPS, OVEC, TVA, FRCC, SERC, ERCOT, WECC	HQ modeled as fixed hourly schedule, synchronized with all other external injections. Full Representation/Participation: NYISO ISONE IESO PJM Classic & AP, AEP, CE, DLCO, DAY, VP, EKPC Proxy Bus Injection: HQ-NYISO, HQ-NE-ISO, NB-NEISO, HQ – IESO Transmission Only/Zeroed Out: MECS, FE, SPP, MAR, NIPS, OVEC, TVA, FRCC, SERC, ERCOT, WECC

External Controllable Lines (PARs, HVDC, VFT, Radial lines)	B and C modeled as out of service. Current JOA modeled under these outage conditions. Western ties to carry 46% of PJM-NYISO AC Interchange + 20% of RECO Load 5018 line to carry 32% of PJM-NYISO AC Interchange + 80% of RECO Load PAR A to carry 7% of PJM-NYISO AC Interchange PAR J-K to carry 15% of PJM-NYISO AC Interchange Norwalk (-200MW, +200MW) L33,34 (-300MW, +300MW) PV20 (0MW, +150MW) Neptune (0MW, +660MW) CSC (0MW, +330MW) CSC and Neptune optimized subject to "cost of use" HTP (0, 660) Linden VFT (-315,315)	B and C modeled as out of service. Current JOA modeled under these outage conditions. Western ties to carry 46% of PJM-NYISO AC Interchange + 20% of RECO Load 5018 line to carry 32% of PJM-NYISO AC Interchange + 80% of RECO Load PAR A to carry 7% of PJM-NYISO AC Interchange PAR J-K to carry 15% of PJM-NYISO AC Interchange Norwalk (-200MW, +200MW) L33,34 (-300MW, +300MW) PV20 (0MW, +150MW) Neptune (0MW, +660MW) CSC (0MW, +330MW) CSC and Neptune optimized subject to "cost of use" HTP (0, 660) Linden VFT (-315,315)	B and C modeled as out of service. Current JOA modeled under these outage conditions. Western ties to carry 46% of PJM-NYISO AC Interchange + 20% of RECO Load 5018 line to carry 32% of PJM-NYISO AC Interchange + 80% of RECO Load PAR A to carry 7% of PJM-NYISO AC Interchange PAR J-K to carry 15% of PJM-NYISO AC Interchange Norwalk (-200MW, +200MW) L33,34 (-300MW, +300MW) PV20 (0MW, +150MW) Neptune (0MW, +660MW) CSC (0MW, +330MW) CSC and Neptune optimized subject to "cost of use" HTP (0, 660) Linden VFT (-315,315)

Appendix D: Capacity Expansion Assumptions Matrix

	Scenario #1 (S1)	Scenario #2 (S2)
Scenario Description	*S1 utilizes industry data and NYISO load forecasts, representing a future with high demand (57,144 MW winter peak and 208,679 GWh energy demand in 2040) and assumes less restrictions in renewable generation buildout options.*	*S2 utilizes various assumptions more closely aligned with the Climate Action Council Integration Analysis and represents a future with a moderate peak but a higher overall energy demand (42,301 MW winter peak and 235,731 GWh energy demand in 2040).*
Existing Generation	Consistent with Policy Case production cost simulation database, noting that the model simulates optimal retirement decisions which may differ from production cost database.	Consistent with Policy Case production cost simulation database, noting that the model simulates optimal retirement decisions which may differ from production cost database.
Existing Generation FOM Costs	Fixed O&M costs for existing generators assumed per 2018 documentation for EPA Platform. Chapter 4: Generating Resources.	Fixed O&M costs for existing generators assumed per 2018 documentation for EPA Platform. Chapter 4: Generating Resources.
Existing Generation Properties	Firm capacity (*i.e.*, UCAP) values based on 2016-2020 historic values, as used in 2020 RNA base case.	Firm capacity (*i.e.*, UCAP) values based on 2016-2020 historic values, as used in 2020 RNA base case.
Chronological Representation	Each year is represented by 17 load blocks. For each year, 16 of the load blocks are represented by slicing hours of the year by season (Spring, Summer, Fall, Winter) and time of day (overnight, morning, afternoon, evening) and one load block per year represents a period of peak load hours. The seasonal/time of day blocks are based on 2018 NREL ReEDS documentation and the peak load hours are based on the input hourly load data.	Each year is represented by 17 load blocks. For each year, 16 of the load blocks are represented by slicing hours of the year by season (Spring, Summer, Fall, Winter) and time of day (overnight, morning, afternoon, evening) and one load block per year represents a period of peak load hours. The seasonal/time of day blocks are based on 2018 NREL ReEDS documentation and the peak load hours are based on the input hourly load data.

Energy Demand & Profile

Energy Forecast based on 2021 Load & Capacity Data Report ("Gold Book") CLCPA Case Forecast of Annual Energy, with modifications to account for the following:

- 10 GW BTM-PV by 2030 CLCPA target,
- Removal of impact from energy storage resources, and
- Smoothed annual electrification forecasts through 2040, maintaining the original forecast for 2040.

Annual Energy in the following table represents net load.

Outlook Scenario S1: Annual Energy Forecast (GWh)

Year	Base Shape	BTM PV	EV	Electrification	Annual Energy
2025	139,863	-7,483	1,922	10,402	144,704
2030	133,856	-11,068	5,488	22,633	150,909
2035	130,775	-11,983	10,322	43,452	172,566
2040	129,178	-12,454	16,361	75,594	208,679

Outlook Scenario S1: Peak Forecasts (MW)

Year	Summer Peak	Winter Peak
2025	31,679	26,491
2030	34,416	31,717
2035	40,033	41,681
2040	48,253	57,144

Outlook Scenario S1: BTM-PV Capacity (MW)

Year	BTM PV
2025	6,834
2030	10,055
2035	10,828
2040	11,198

Energy Forecast based on Appendix G: Annex 2: Key Drivers and Outputs of the Climate Action Council draft scoping plan Strategic Use of Low Carbon Fuels Scenario ("Scenario 2"), with modifications to account for the following:

- Removal of impact from electrolysis loads (*i.e.*, Hydrogen), and
- Adoption of "No End Use Flexibility" sensitivity.

Annual Energy in the following table represents gross load.

Outlook Scenario S2: Annual Energy Forecast (GWh)

Year	BTM PV	Annual Energy
2025	-7,631	150,047
2030	-14,461	164,256
2035	-17,223	204,702
2040	-23,220	235,731

Outlook Scenario S2: Peak Forecasts (MW)

Year	Summer Peak	Winter Peak
2025	29,612	21,758
2030	30,070	25,892
2035	34,402	35,093
2040	38,332	42,301

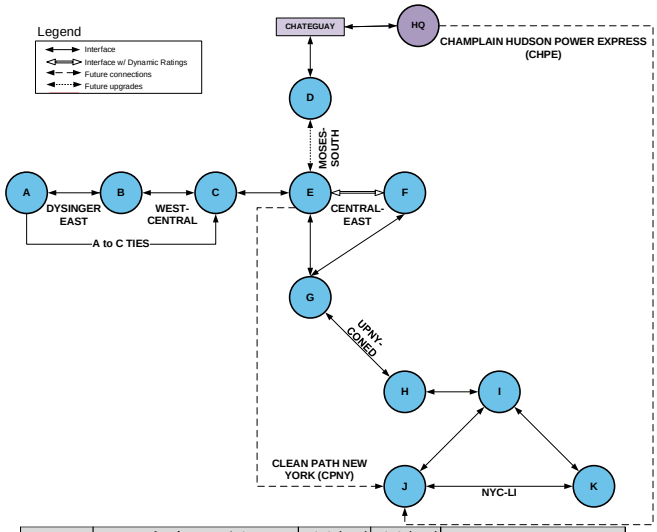
Outlook Scenario S2: BTM-PV Capacity (MW)

Year	BTM PV
2025	6,000
2030	9,523
2035	11,601
2040	15,764

<table>
<tr>
<td>Existing Transmission</td>
<td>
Nodal to zonal reduction performed by PLEXOS to create a pipe-and-bubble equivalent model, where intra-zonal lines are collapsed.

Voltage and stability limited interface limits consistent with Policy Case production cost simulation database. Thermally limited pipe limits set to sum of thermal normal ratings of each interface line (N-0 normal limit).

Applicable N-X contingencies modeled explicitly in production cost simulation.



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<tr><th>Years</th><th>Interface/Interzonal Pipes</th><th>+ Limit (MW)</th><th>- Limit (MW)</th><th>Source</th></tr>
<tr><td>All</td><td>DYSINGER EAST</td><td>2,700</td><td>*</td><td>2020 ATR</td></tr>
<tr><td>All</td><td>A to C TIES</td><td>550</td><td>0</td><td>2021 CRP limit</td></tr>
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<tr><td>All</td><td>DUNWOODI-NYC</td><td>*</td><td>*</td><td></td></tr>
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<tr><td>All</td><td>NYC-LI</td><td>0</td><td>-350</td><td>Wheel contract</td></tr>
<tr><td>2027-2040</td><td>CLEAN PATH NEW YORK</td><td>1,300</td><td>0</td><td>Tier 4 contracts [4]</td></tr>
<tr><td>2025-2040</td><td>CHAMPLAIN HUDSON POWER EXPRESS</td><td>1,250</td><td>0</td><td>Tier 4 contracts [4]</td></tr>
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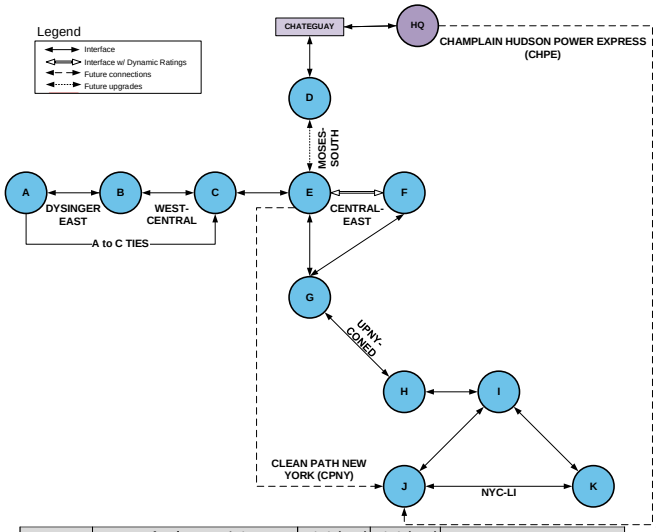
Nodal to zonal reduction performed by PLEXOS to create a pipe-and-bubble equivalent model, where intra-zonal lines are collapsed.

Voltage and stability limited interface limits consistent with Policy Case production cost simulation database. Thermally limited pipe limits set to sum of thermal normal ratings of each interface line (N-0 normal limit).

Applicable N-X contingencies modeled explicitly in production cost simulation.



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Transmission expansion not enabled in PLEXOS as a modeling option.

New policy-based transmission projects included:
-NYPA Northern New York Priority Transmission Project
-Champlain Hudson Power Express
-Clean Path New York
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New policy-based transmission projects included:
-NYPA Northern New York Priority Transmission Project
-Champlain Hudson Power Express
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New Generation Types	Updated to include units with financial contracts, including state sponsored programs, per firm builds as noted in large-scale renewable projects reported by NYSERDA. Specific generation added to the Contract Case is assumed as firm builds in the Policy Case. Updated to include units to support achievement of state and federal policies, per 2021 EIA Energy Outlook. Capacity expansion is limited to the NYCA, where each zone assumes one candidate generator per technology. Generation types from 2021 EIA Energy Outlook Table 3 assumed in model: land based wind offshore wind utility PV 4-hour battery storage In addition to the generator types noted above, Dispatchable Emission Free Resource (DEFR) has been added as a candidate technology type for years 2030 and beyond, with additional details below.	Updated to include units with financial contracts, including state sponsored programs, per firm builds as noted in large-scale renewable projects reported by NYSERDA. Specific generation added to the Contract Case is assumed as firm builds in the Policy Case. Updated to include units to support achievement of state and federal policies, per 2021 EIA Energy Outlook. Capacity expansion is limited to the NYCA, where each zone assumes one candidate generator per technology. Generation types from 2021 EIA Energy Outlook Table 3 assumed in model: land based wind offshore wind utility PV 4-hour battery storage In addition to the generator types noted above, Dispatchable Emission Free Resource (DEFR) has been added as a candidate technology type for years 2030 and beyond, with additional details below.

New Generation Costs

Overnight (capital) costs, fixed O&M, and variable O&M costs assumed per 2021 EIA Energy Outlook.

Overnight costs, fixed O&M and variable O&M costs for Dispatchable Emission Free Resource (DEFR) options will represent a range of costs. Assumed costs for the Dispatchable Emission Free Resource (DEFR) options are:

Candidate Capacity Expansion Technology	Capital Cost ($/kW)	Variable O&M Costs ($/MWh)	Fuel Cost ($/mmBtu)	Heat Rate (mmBtu/MWh)
High Operating/Low Capital	1,000	16	40	6.37
Medium Operating/Medium Capital	4,500	9	23	6.37
Low Operating/High Capital	8,000	2	5	6.37

Regional multipliers assumed for candidate generators by zone are based on the 2021 EIA Energy Outlook and the Climate Action Council Integration Analysis Assumptions (Accessed Assumptions at https://climate.ny.gov/Climate-Resources December 10, 2021). Regional multipliers assumed for candidate battery storage units are based on the 2021 EIA Energy Outlook and 2021-2025 Demand Curve Reset.

Candidate Technology	Base Capital	Zonal Multiplier for Capital Costs										
		A	B	C	D	E	F	G	H	I	J	K
Utility PV	1,248	1.05	1.04	1.04	1.01	1.01	1.04	1.20	-	-	-	1.39
Land based wind	1,846	0.98	0.96	1.02	1.06	1.03	1.06	1.14	-	-	-	-
Offshore wind	4,362	-	-	-	-	-	-	-	-	-	1.01	1.01
4-hour battery storage	1,165	1.00	1.00	1.00	1.00	1.00	1.01	1.02	1.02	1.02	1.28	1.10
LcHo DEFR	1,000	1	1	1	1	1	1	1	1	1	1	1
McMo DEFR	4,500	1	1	1	1	1	1	1	1	1	1	1
HcLo DEFR	8,000	1	1	1	1	1	1	1	1	1	1	1

Technological optimism factors applied to capital costs per NREL 2020-ATB-data.

Candidate Technology	Technology Optimism Factors by Year				
	2020	2025	2030	2035	2040
Utility PV	1	0.81	0.62	0.59	0.56
Land based wind	1	0.90	0.79	0.75	0.71
Offshore wind	1	0.81	0.70	0.63	0.59
4-hour battery storage	1	0.69	0.56	0.53	0.49
DEFR	n/a	n/a	1	1	1

Overnight (capital) costs, fixed O&M, and variable O&M costs assumed per 2021 EIA Energy Outlook.

Overnight costs, fixed O&M and variable O&M costs for Dispatchable Emission Free Resource (DEFR) options will represent a range of costs. Assumed costs for the Dispatchable Emission Free Resource (DEFR) options are:

Candidate Capacity Expansion Technology	Capital Cost ($/kW)	Variable O&M Costs ($/MWh)	Fuel Cost ($/mmBtu)	Heat Rate (mmBtu/MWh)
Medium Operating/Medium Capital	4,500	9	23	6.37

Regional multipliers assumed for candidate generators by zone are based on the 2021 EIA Energy Outlook and the Climate Action Council Integration Analysis Assumptions (Accessed Assumptions at https://climate.ny.gov/Climate-Resources December 10, 2021). Regional multipliers assumed for candidate battery storage units are based on the 2021 EIA Energy Outlook and 2021-2025 Demand Curve Reset. Regional multipliers for candidate Dispatchable Emission Free Resource (DEFR) units are based on regional multipliers for the combined cycle technology option in the 2021 EIA Energy Outlook.

Candidate Technology	Base Capital	Zonal Multiplier for Capital Costs										
		A	B	C	D	E	F	G	H	I	J	K
Utility PV	1,248	1.05	1.04	1.04	1.01	1.01	1.04	1.20	-	-	-	1.39
Land based wind	1,846	0.98	0.96	1.02	1.06	1.03	1.06	1.14	-	-	-	-
Offshore wind	4,362	-	-	-	-	-	-	-	-	-	1.01	1.01
4-hour battery storage	1,165	1.00	1.00	1.00	1.00	1.00	1.01	1.02	1.02	1.02	1.28	1.10
McMo DEFR	4,500	1	1	1	1	1	1	1.14	1.14	1.14	1.39	1.30

Technological optimism factors applied to capital costs per NREL 2020-ATB-data.

Candidate Technology	Technology Optimism Factors by Year				
	2020	2025	2030	2035	2040
Utility PV	1	0.81	0.62	0.59	0.56
Land based wind	1	0.90	0.79	0.75	0.71
Offshore wind	1	0.81	0.70	0.63	0.59
4-hour battery storage	1	0.69	0.56	0.53	0.49
DEFR	n/a	n/a	1	1	1

New Generation Properties	Unit heat rates per 2021 EIA Energy Outlook. The heat rates for the Dispatchable Emission Free Resource (DEFR) option are consistent with the combined cycle technology option in the 2021 EIA Energy Outlook. The Dispatchable Emission Free Resource (DEFR) technologies are modeled as flexible resources with parameters consistent with the combined cycle technology option in the 2021 EIA Energy Outlook. Linear capacity expansion by technology-zone. Maximum allowable capacities are enforced for applicable generator types based on 2040 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan. The firm capacity (*i.e.*, UCAP) values for the Dispatchable Emission Free Resource (DEFR) option are consistent with the combined cycle technology option, based on default derating factor value from the NERC GADS database. Firm capacity values for Land based wind, offshore wind, utility PV, and battery storage units are modeled as having a declining capacity value as a function of that generator type's installed capacity. These values are based on the 2020 Grid in Evolution Study.	Unit heat rates per 2021 EIA Energy Outlook. The heat rates for the Dispatchable Emission Free Resource (DEFR) option are consistent with the combined cycle technology option in the 2021 EIA Energy Outlook. The Dispatchable Emission Free Resource (DEFR) technologies are modeled as flexible resources with parameters consistent with the combined cycle technology option in the 2021 EIA Energy Outlook. Linear capacity expansion by technology-zone. Maximum allowable capacities are enforced for applicable generator types based on 2040 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan. For land-based wind, the maximum allowable capacities enforced for model years 2021-2030 are based on 2030 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan. The firm capacity (*i.e.*, UCAP) values for the Dispatchable Emission Free Resource (DEFR) option are consistent with the combined cycle technology option, based on default derating factor value from the NERC GADS database. Firm capacity values for Land based wind, offshore wind, utility PV, and battery storage units are modeled as having a declining capacity value as a function of that generator type's installed capacity. These values are based on the 2020 Grid in Evolution Study.
Capacity Reserve Margin	Capacity reserve margins (IRM and LCRs) for 2021-2022 Capability Year translated to UCAP equivalent for model years, per NYISO ICAP to UCAP translation. The minimum capacity reserve margin for the G-J Locality assumes a 10% reduction in its requirement due to future impacts from AC Transmission. Minimum UCAP requirements by capacity zone are as follows: • NYCA: 110.11% summer, 110.56% winter • Zones G-J: 84.43% summer, 83.69% winter model years 2021-2023, 74.43% summer, 73.69% winter model years 2024-2040 • Zone J: 78.14% summer, 78.31% winter • Zone K: 97.85% summer, 95.48% winter	Capacity reserve margins (IRM and LCRs) for 2021-2022 Capability Year translated to UCAP equivalent for model years, per NYISO ICAP to UCAP translation. The minimum capacity reserve margin for the G-J Locality assumes a 10% reduction in its requirement due to future impacts from AC Transmission. Minimum UCAP requirements by capacity zone are as follows: • NYCA: 110.11% summer, 110.56% winter • Zones G-J: 84.43% summer, 83.69% winter model years 2021-2023, 74.43% summer, 73.69% winter model years 2024-2040 • Zone J: 78.14% summer, 78.31% winter • Zone K: 97.85% summer, 95.48% winter

Policy Targets and Other Model Constraints	CLCPA targets and other state policy mandates modeled include: • 6 GW BTM-PV by 2025 • 70% renewable energy by 2030 • 3 GW energy storage by 2030 • 10 GW BTM-PV by 2030 • 9 GW offshore wind by 2035 • 100% emission free grid by 2040 As noted above, maximum allowable capacities are enforced for applicable generator types by zone based on 2040 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan.	CLCPA targets and other state policy mandates modeled include: • 6 GW BTM-PV by 2025 • 70% renewable energy by 2030 • 3 GW energy storage by 2030 • 10 GW BTM-PV by 2030 • 9 GW offshore wind by 2035 • 100% emission free grid by 2040 As noted above, maximum allowable capacities are enforced for applicable generator types by zone based on 2040 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan. For land-based wind, the maximum allowable capacities enforced for model years 2021-2030 are based on 2030 limitations, per Appendix G: Annex 1: Inputs and Assumptions of the Climate Action Council Draft Scoping Plan.