AC Transmission Public Policy Transmission Planning Report

A Report by the
New York Independent System Operator

DRAFT

~~April 25~~May 29, 2018

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Executive Summary

This ~~draft~~ report presents the ~~preliminary~~ results of the Public Policy Transmission Planning Process administered by the New York Independent System Operator (NYISO) for the AC Transmission Public Policy Transmission ~~Need~~Needs. It represents the culmination of a multi-year joint effort by the NYISO, the New York State Public Service Commission (PSC), Developers, and stakeholders to address transmission needs associated with the Central East and Upstate New York/Southeast New York (UPNY/SENY) interfaces. The NYISO conducted extensive evaluations of the proposed viable and sufficient transmission projects and recommends the ranking and selection of the more efficient or cost-effective transmission solutions to the AC Transmission Public Policy Transmission Needs as described herein.

The NYISO commenced the Public Policy Transmission Planning Process for the first time by soliciting proposed transmission needs driven by Public Policy Requirements from NYISO's stakeholders and other interested parties. The NYISO filed the proposed transmission needs for consideration by the PSC, which, upon considering various comments submitted, issued an order that found significant benefits could be achieved by relieving the transmission constraints along the Central East and UPNY/SENY corridors. The PSC, therefore, adopted the AC Transmission Public Policy Transmission Needs ("AC Transmission Needs") specifically consisting of two segments: Segment A (Central East interface) and Segment B (UPNY/SENY interface). A key objective is to utilize existing rights-of-way to increase Central East capability by at least 350 MW and UPNY/SENY capability by at least 900 MW. Further details of the AC Transmission Needs are provided in Section 2.

The NYISO performed analysis to identify the specific transmission constraints in the transmission system in Central, Eastern, and Southeastern New York. Following review of the baseline analysis and discussions with stakeholders and prospective Developers, the NYISO issued a solicitation for solutions to address the AC Transmission Needs. The NYISO conducted the Viability and Sufficiency Assessment to address the needs, and identified thirteen viable and sufficient projects. Details of the proposed projects are provided in Section 3.

Following the PSC's review of the Viability and Sufficiency Assessment and consideration of public comments, the PSC issued an order confirming the AC Transmission Needs. Upon issuance of the order confirming the need for transmission, the NYISO immediately commenced a detailed evaluation of each viable and sufficient transmission proposal with the assistance of its independent consultant, Substation Engineering Company (SECO).

In determining which of the viable and sufficient proposed transmission projects are the more efficient or cost-effective solutions to satisfy the AC Transmission Needs, the NYISO considered the metrics set forth in the tariff and ranked each proposed project based on the its performance under these metrics. These metrics include capital costs, cost per MW, expandability, operability, performance, property rights and routing, risks to siting and operation, development schedule, and other metrics such as production cost savings, locational based marginal price (LBMP) savings, emissions savings, and congestion.

A core concept of the NYISO's evaluation and selection process is the use of an independent consultant to review each proposed project and apply a consistent methodology across all projects for establishing cost estimates, schedule estimates, and routing assessments. Utilizing detailed project information provided by the Developers, SECO developed independent capital cost and schedule estimates considering material and labor cost by equipment, engineering and design work, permitting, site acquisition, procurement and construction work, and commissioning needed for the proposed project. SECO's cost estimates for the proposed transmission projects range from $491 million to $863 million for Segment A projects and $338 million to $502 million for Segment B projects, with schedules ranging from 52 months to 55 months for Segment A projects and 47 months to 51 months for Segment B projects following the NYISO's selection.

A key objective of the AC Transmission Needs is to increase Central East and UPNY/SENY transfer capability. Each project's efficiency in achieving this objective is measured in a number of ways utilizing power flow and production cost simulations under a variety of system dispatches and conditions. To determine the cost effectiveness of each project, the NYISO compared these electrical results to SECO's independent capital cost estimate for each project. Further, the increased transfer capability and relief of these New York transmission constraints would result in production cost savings of as much as $337 million for the baseline system assumptions, and $1,129 million for the Clean Energy Standard (CES) + generation retirement scenario over the first 20 years of a project being in-service. The achieved savings may vary for each transmission project depending on the project design and system conditions in the future. The NYISO also assessed the potential capacity procurement savings that may be realized if the AC Transmission Needs are addressed. Although the NYISO continues to refine its capacity savings metric and did not use it to rank projects, the potential range of capacity savings of $550 to $850 million supports the recommendation for selection of a project to meet the transmission needs consistent with NYISO's competitive markets and the interests of consumers.

The NYISO also considers qualitative metrics such as expandability, operability, and performance. The NYISO considered how the proposed projects affect the flexibility in operating the system, such as dispatch of generation, access to operating reserves, access to ancillary services, and the ability to remove transmission for maintenance. Certain projects afford greater expandability opportunities through substation design and transmission line configurations, while other projects offer greater operability of the system through improved performance under outage conditions or better integration of facilities with the overall system.

A two-step process was used to rank the Segment A and Segment B projects, as detailed in Section 4. Projects in each segment were first analyzed individually, and then compared against each other to identify the major performance and risk differences as distinguishing factors. Metrics analyzed in this step include independent cost estimates, duration estimates, transfer capability, operability, expandability, property rights, replacement of aging infrastructure, and risks to project siting and operation. In the second step, combinations of Segment A and Segment B projects were compared based on consideration of all the evaluation metrics for efficiency or cost effectiveness. Cost savings were considered for synergies that may be realized for Segment A and Segment B projects proposed by the same developers. Improved system efficiency or cost effectiveness was also considered due to the combined electrical characteristics regardless of whether the projects are proposed by the same developers or not. The combination results were then used to inform the numerical ranking in each Segment. Based on consideration of all the evaluation metrics for efficiency or cost effectiveness, together with input from stakeholders and the New York State Department of Public Service (DPS), the NYISO staff recommends that the NYISO Board of Directors selects the Segment A Double-Circuit proposal (T027) and the Segment B Base proposal (T029) as the more efficient or cost-effective transmission solutions to satisfy the AC Transmission Public Policy Transmission Needs, each of which were proposed jointly by North America Transmission and the New York Power Authority.

Major components of T027 include a new 86-mile double-circuit line between the Edic and New Scotland 345 kV substations, and the addition of a new Princetown 345 kV switchyard to connect to Rotterdam. The double-circuit line will utilize rights-of-way currently occupied by the Porter-Rotterdam 230 kV lines that will be decommissioned as part of the project. The benefits provided by the double-circuit 345 kV design include significant increases in Central East transfer capability, increased production cost savings, and excellent operability and expandability. T027 also has the lowest electromagnetic field (EMF) risk due to the EMF cancelling effect of the double circuit design. Therefore, the overall quantitative and qualitative benefits of T027 warrant the higher cost relative to some other Segment A proposals.

Major components of T029 include a new Knickerbocker 345 kV switching station on the existing New Scotland to Alps 345 kV line, and a new 345 kV line from Knickerbocker to Pleasant Valley. The project includes various modifications to the 115 kV system between Greenbush and Pleasant Valley to allow for use of existing rights-of-way to accommodate the 345 kV line. T029 has the second lowest cost of the Segment B projects and provides similar UPNY/SENY transfer capability and production cost savings, while demonstrating excellent operability. Moreover, T029 is assessed to have the lowest siting risk due to the lower increases in structure height compared to other projects; in fact, more than half of its new structures will be lower than existing structure heights along the right-of-way.

The combination of T027 and T029 is estimated to cost $1,080 million, taking into consideration a 30% contingency factor and a 5% discount for cost efficiency synergies of having a single developer for both projects. The projects are expected to provide combined production cost savings and capacity procurement savings in a range of $881 million to $1,979 million depending on future system conditions. Based on the project schedule for T027 and T029 estimated by SECO, the in-service date for the selected projects is April 2023 if there is no major delay in siting. Following the approval of this report and selection of the projects by the Board of Directors, the NYISO will tender a Development Agreement for the selected transmission projects.

1. The Public Policy Transmission Planning Process

The Public Policy Transmission Planning Process (PPTPP) is the newest component of the NYISO's Comprehensive System Planning Process and considers transmission needs driven by Public Policy Requirements in the local and regional transmission planning processes. The Public Policy Transmission Planning Process was developed in consultation with NYISO stakeholders and the New York State Public Service Commission (PSC), and was approved by the Federal Energy Regulatory Commission (FERC) under Order No. 1000.[1] At its core, the Public Policy Transmission Planning Process provides for the NYISO's evaluation and selection of transmission solutions to satisfy a transmission need driven by Public Policy Requirements. The process was developed to encourage both incumbent and non-incumbent transmission developers to propose projects in response to an identified need.

The NYISO is responsible for administering the Public Policy Transmission Planning Process in accordance with Attachment Y to its Open Access Transmission Tariff (OATT). Consistent with its obligations to regulate and oversee the electric industry under New York State law, the PSC has the primary responsibility for the identification of transmission needs driven by Public Policy Requirements.

A Public Policy Transmission Planning Process cycle typically commences every two years following the posting of the draft Reliability Needs Assessment study results, and consists of four core steps—(1) the identification of a Public Policy Transmission Need, (2) developers proposing solutions to satisfy the identified Public Policy Transmission Need, (3) an evaluation of the viability and sufficiency of the proposed Public Policy Transmission Projects and Other Public Policy Projects, and (4) a comparative evaluation of the viable and sufficient projects for the NYISO Board of Directors to select the more efficient or cost-effective Public Policy Transmission Project that satisfies the Public Policy Transmission Need, if the PSC confirms that there is a need for transmission. The selected Public Policy Transmission Project is eligible for cost allocation and cost recovery under the NYISO's tariffs.

[1] *See New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 143 FERC ¶ 61,059 (April 18, 2013); *New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 148 FERC ¶ 61,044 (July 17, 2014); *New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 151 FERC ¶ 61,040 (April 16, 2015); *New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 155 FERC ¶ 61,037 (April 18, 2016); *New York Indep. Sys. Operator, Inc.*, Order on Compliance Filing, 162 FERC ¶ 61,107 (February 15, 2018).

1.1 Identification of a Public Policy Transmission Need

For each cycle of the Public Policy Transmission Planning Process, the NYISO begins the process by inviting stakeholders and interested parties to submit proposed transmission needs driven by Public Policy Requirements. A Public Policy Requirement includes an existing federal, state, or local law or regulation, or a new legal requirement that the PSC establishes after public notice and comment under New York State law.

Following the submission of proposals, the NYISO posts all submittals on its website and provides those submissions, including any proposal from the NYISO, to the PSC. The NYISO separately provides any submission that proposes the identification of transmission needs driven by Public Policy Requirements within the Long Island Transmission District to the Long Island Power Authority (LIPA). The PSC and LIPA, as applicable, consider the proposals in order to identify any Public Policy Transmission Needs, and the PSC determines whether the NYISO should solicit solutions to any of the identified needs.

1.2 Solicitation for Proposed Solutions

After the PSC determines that a Public Policy Transmission Need or a transmission need solely within the Long Island Transmission District driven by a Public Policy Requirement should be evaluated and considered by the NYISO for selection and regional cost allocation, the NYISO solicits proposed solutions that Developers believe will satisfy the identified need. Developers are afforded 60 days to propose their solutions and are required to provide specific Developer qualification and project information as detailed in Attachment Y to the OATT, the Public Policy Transmission Planning Process Manual, and the NYISO's solicitation.

Under the Public Policy Transmission Planning Process, proposed solutions fall into two categories—(i) Public Policy Transmission Projects and (ii) Other Public Policy Projects. A Public Policy Transmission Project is a transmission project or a portfolio of transmission projects proposed by a qualified Developer to satisfy an identified Public Policy Transmission Need and for which the Developer seeks to be selected by the NYISO for purposes of allocating and recovering the project's costs under the NYISO OATT. An Other Public Policy Project is a non-transmission project (*i.e.*, generation or demand-side projects) or a portfolio of transmission and non-transmission projects proposed by a Developer to satisfy an identified Public Policy Transmission Need. The NYISO will determine whether an Other Public Policy Project is viable and sufficient to meet a Public Policy Transmission Need. However, an Other Public Policy Project is not entitled to cost allocation and recovery under the NYISO OATT.

1.3 Evaluation for Viability and Sufficiency

In the first phase of ~~analyses~~analysis, the NYISO evaluates each proposed solution to the Public Policy Transmission Need to determine whether it is viable and sufficient. The NYISO assesses all resources types on a comparable basis within the same general timeframe. Under the viability evaluation, the NYISO considers a Developer's qualification and the project information data to determine whether the project is technically practicable, whether there is the ability to obtain the necessary rights-of-way within the required timeframe, and whether the project could be completed within the required timeframe. Under the sufficiency evaluation, the NYISO evaluates the degree to which each proposed solution independently satisfied the Public Policy Transmission Need, including any specific criteria established by the PSC in its order identifying the need. After completing the viability and sufficiency evaluations, the NYISO presents the assessment to stakeholders, interested parties, and the PSC for review and comments.

Following the NYISO's presentation of the Viability and Sufficiency Assessment, the Public Policy Transmission Planning Process requires the PSC to review the assessment and issue an order. If the PSC concludes that there is no longer a transmission need driven by a Public Policy Requirement, the NYISO will not perform an evaluation, or make a selection of, a more efficient or cost-effective transmission solution for that planning cycle. If the PSC modifies the transmission need driven by a Public Policy Requirement, the NYISO will restart its Public Policy Transmission Planning Process as an out-of-cycle process. This out-of-cycle process begins with the NYISO's solicitation of Public Policy Transmission Projects to address the modified Public Policy Transmission Need. The NYISO evaluates the viability and sufficiency of the proposed Public Policy Transmission Projects. The NYISO then proceeds to evaluate the viable and sufficient Public Policy Transmission Projects for purposes of selecting the more efficient or cost-effective transmission solution to the modified Public Policy Transmission Need.

1.4 Evaluation for Selection as the More Efficient or Cost-Effective Solution

Once the PSC determines that there ~~remains~~continues to be a transmission need driven by a Public Policy Requirement, the NYISO proceeds with the evaluation of the proposed Public Policy Transmission Projects. The NYISO only considers those Public Policy Transmission Projects that it determined to be viable and sufficient and that have provided the required notifications to proceed with the evaluation for selection as the more efficient or cost-effective solution to the identified need.

The NYISO's selection is based on the totality of its evaluation of the eligible projects using the pre-defined metrics set forth in Attachment Y of the OATT and others set by the PSC and/or in consultation with stakeholders. The NYISO uses the project information provided by the Developer at the start of the process, in addition to any other information available to the NYISO. In performing its evaluation, the NYISO~~, or~~ and its an independent consultant, reviews the reasonableness and comprehensiveness of the information submitted by the Developer for each project that is eligible for selection to be measured against the specific evaluation metrics (*see* Section 3.2, below).

In determining which of the eligible proposed regulated Public Policy Transmission Projects is the more efficient or cost-effective solution to satisfy the Public Policy Transmission Need, the NYISO considers each project's total performance under all of the selection metrics. The NYISO may develop scenarios that modify certain assumptions to evaluate the proposed Public Policy Transmission Projects under differing system conditions. The NYISO considers and ranks each proposed solution based on its performance under the metrics. Based upon its evaluation of each viable and sufficient Public Policy Transmission Project, the NYISO staff recommends in the draft Public Policy Transmission Planning Report what project is the more efficient or cost-effective solution to satisfy the Public Policy Transmission Need, if any. After the draft report is reviewed through the collaborative governance process and by the Market Monitoring Unit, the NYISO Board of Directors may approve the report, including whether to select a Public Policy Transmission Project, or propose modifications.

1.5 Identifying a Cost Allocation Methodology for the Public Policy Transmission Need

Under the Public Policy Transmission Planning Process and consistent with FERC's directives under Order No. 1000, a regulated transmission project that is selected as the more efficient or cost-effective solution to satisfy an identified Public Policy Transmission Need will be eligible to receive cost allocation and recovery under the OATT. The Public Policy Transmission Planning Process contains an approved load ratio share cost allocation methodology, and a multi-step process for identifying any alternative methodology. This process was designed to provide flexibility in prescribing a methodology that would allocate the costs of a selected Public Policy Transmission Project consistent with the Public Policy Requirement driving the identified transmission need and roughly commensurate with the derived benefits. In allocating the costs of the selected Public Policy Transmission Project, the NYISO will use the default methodology under Attachment Y to the OATT or an alternative methodology proposed in this process and accepted by FERC. The cost allocation methodology eventually accepted by the Commission has no bearing on the NYISO's selection of the more efficient or cost-effective transmission project to meet the Public Policy Transmission Need.

2. AC Transmission Public Policy Transmission ~~Need~~Needs

2.1 Identification of AC Transmission Public Policy Transmission ~~Need~~Needs

The NYISO issued a letter on August 1, 2014, inviting stakeholders and interested parties to submit proposed transmission needs driven by Public Policy Requirements to the NYISO on or before September 30, 2014.[2] On October 3, 2014, the NYISO filed the proposed needs for consideration with the PSC.[3] These proposed needs had two common and recurring themes: (i) increase transfer capability between upstate and downstate, and (ii) mitigate transmission constraints in Western New York to facilitate full output from the Niagara hydroelectric power plant and imports from Ontario. The PSC issued notices soliciting public comments on the proposed needs on November 12, 2014, and numerous parties submitted comments.[4]

Prior to the NYISO's solicitation of proposed transmission needs driven by Public Policy Requirements, the PSC initiated the Alternating Current Transmission Upgrades proceedings to consider whether to address the persistent transmission congestion that exists at the Central East and Upstate New York/Southeast New York (UPNY/SENY) electrical interfaces on the New York State Transmission System.[5] In those proceedings, the PSC sought and received in January 2013 numerous proposed projects to address the PSC's public policy objective with the intent of increasing transfer capability by approximately 1,000 MW based upon the recommendation of the Governor's Energy Highway Task Force. In response to the 2014 State of the State Address encouraging utilities and transmission developer to build solely within existing rights-of-way corridors, the PSC afforded the opportunity for revisions to the proposals, and four entities proposed 22 revised proposals.

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2 The NYISO's letter can be obtained at the following link: http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp.

3 The proposed needs and the NYISO's submission of the needs can be obtained at the following link: http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=14-E-0454&submit=Search.

4 The notices seeking comments were issued under PSC Case Nos. 12-T-0502, *et al.*, and PSC Case No. 14-E-0454, and the comments can be obtained from the Department of Public Service website: http://www.dps.ny.gov/.

5 The UPNY/SENY interface represents a collection of transmission on which power flows from upstate New York to southeast New York, and is comprised of: two 345 kV lines from Utica to south of the Catskills (commonly known as "Marcy South"); three 345 kV lines from Athens to Kingston and Pleasant Valley, in addition to underlying 115 kV lines (commonly known as "Leeds South"); and one 345 kV line from Connecticut to Pleasant Valley (commonly known as "Pleasant Valley-Long Mountain").

Following the PSC's receipt and review of comments in response to the NYISO's invitation for proposed transmission needs driven by Public Policy Requirements, the PSC continued its efforts in the Alternating Current Transmission Upgrades comparative proceedings and sought to coordinate its comparative evaluation of proposed projects with the NYISO's Public Policy Transmission Planning Process. During the period in which the PSC was considering comments, the PSC requested that the NYISO perform analysis of the 22 proposed projects proposed in the PSC's proceedings. On July 6, 2015, DPS posted the Trial Staff Interim Report with the initial results of the NYISO's evaluation, and the NYISO, on July 20, 2015, presented the initial results at a technical conference hosted by New York State Department of Public Service (DPS) in the Alternating Current Transmission Upgrades proceedings.

Thereafter, due to public information that the CPV Valley Energy Center—a 680 MW generation facility that would interconnect to the New York State Transmission System at Dolson Avenue Substation—received its financing and would commence construction, DPS requested the NYISO to update its analysis to consider the effects of the CPV Valley Energy Center. On September 22, 2015, DPS issued its Trial Staff Final Report, containing the results of the NYISO's analysis, and a companion motion recommending that the Commission find that there ~~is a~~are transmission ~~need~~needs driven by Public Policy Requirements to move power from upstate to downstate over the Central East and UPNY/SENY interfaces.

Following presentation of the Trial Staff Final Report at a technical conference in October 2015, the PSC issued an order, on December 17, 2015, identifying numerous public policies[6] that, taken

[6] The PSC identified that, as it relates to the AC Transmission ~~Need~~Needs, it is the public policy of the state to: reduce transmission congestion so that large amounts of power can be transmitted to regions of New York where it is most needed; to reduce production costs through congestion relief; reduce capacity resource costs; to improve market competition and liquidity; to enhance system reliability, flexibility, and efficiency; to improve preparedness for and mitigation of impacts of generator retirements; enhance resiliency/storm hardening; to avoid refurbishment costs of aging transmission; to take better advantage of existing fuel diversity; to increase diversity in supply, including additional renewable resources; to promote job growth and the development of new efficient generation resources Upstate; to reduce environmental and health impacts through reductions in less efficient electric generation; to reduce costs of meeting renewable resource standards; to increase tax receipts from increased infrastructure investment; to enhance planning and operational flexibility; to obtain synergies with other future transmission projects; and to relieve gas transportation constraints. December 2015 Order at pp 66-67. In addition, the Commission found that the 2015 State Energy Plan (containing the New York's Energy Highway Blueprint), Section 6-104(1) of the New York Energy Law that requires the State Energy Planning Board to adopt a State Energy Plan, and Section 6-104(5)(b) of the New York Energy Law constitute Public Policy Requirements. *See id.* at pp 67-68.

together, constitute Public Policy Requirements driving transmission needs associated with the Central East and UPNY/SENY interfaces on the New York State Transmission System (collectively, "AC Transmission ~~Need~~Needs").[7] The PSC distinguished the transmission ~~need~~needs based on each affected system—*i.e.*, Central East (Segment A) and UPNY/SENY (Segment B), and described the transmission needs on the two segments as follows:

SEGMENT A

Edic/Marcy to New Scotland; Princetown to Rotterdam

Construction of a new 345 kV line from Edic or Marcy to New Scotland on existing right-of-way (primarily using Edic to Rotterdam right-of-way west of Princetown); construction of two new 345 kV lines or two new 230 kV lines from Princetown to Rotterdam on existing Edic to Rotterdam right-of-way; decommissioning of two 230 kV lines from Edic to Rotterdam; and related switching or substation work at Edic or Marcy, Princetown, Rotterdam and New Scotland.

SEGMENT B

Knickerbocker to Pleasant Valley

Construction of a new double circuit 345 kV/115 kV line from Knickerbocker to Churchtown on existing Greenbush to Pleasant Valley right-of-way; construction of a new double circuit 345 kV/115 kV line or triple circuit 345 kV/115 kV/115 kV line from Churchtown to Pleasant Valley on existing Greenbush to Pleasant Valley right-of-way; decommissioning of a double-circuit 115 kV line from Knickerbocker to Churchtown; decommissioning of one or two double-circuit 115 kV lines from Knickerbocker to Pleasant Valley; construction of a new tap of the New Scotland-Alps 345 kV line and new Knickerbocker switching station; and related switching or substation work at Greenbush, Knickerbocker, Churchtown and Pleasant Valley substations.

Upgrades to the Rock Tavern Substation Terminal Equipment

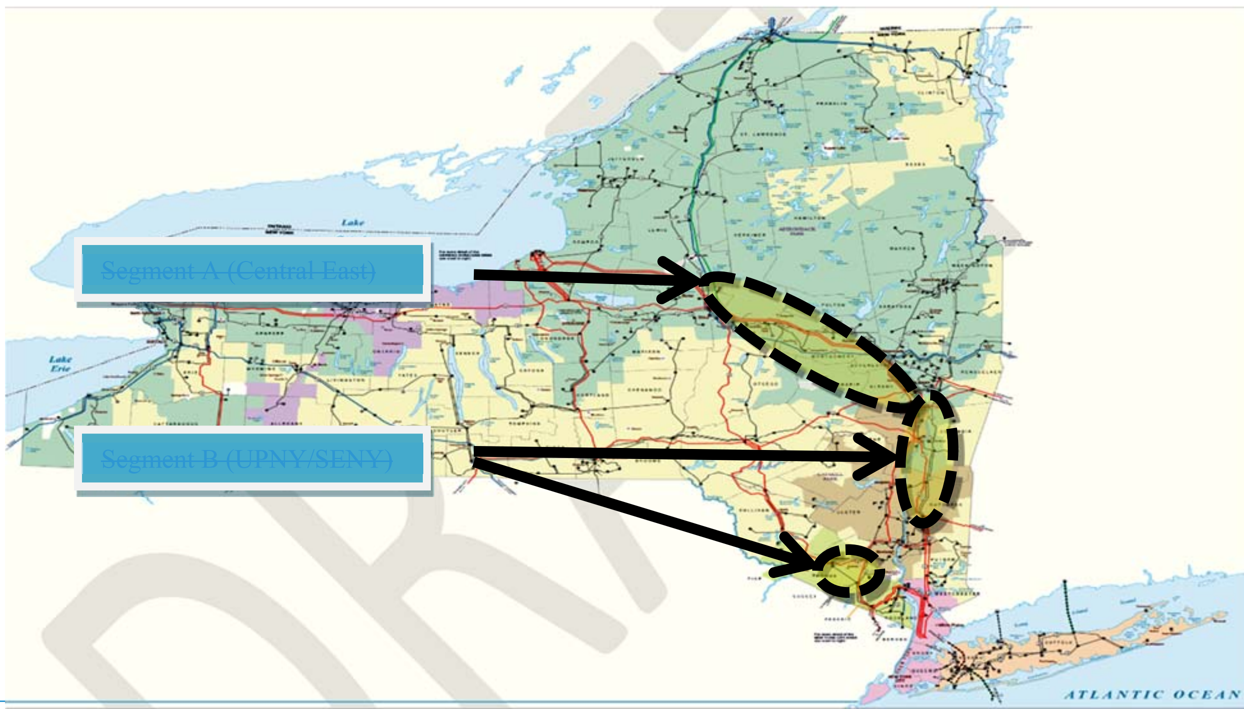
New line traps, relays, potential transformer upgrades, switch upgrades, system control upgrades and the installation of data acquisition measuring equipment and control wire needed to handle higher line currents that will result as a consequence of the new Edic/Marcy to New Scotland; Princetown to Rotterdam and Knickerbocker to Pleasant Valley lines.

[7] *See* December 2015 Order, at p 68 & Appendix A.

Shoemaker to Sugarloaf

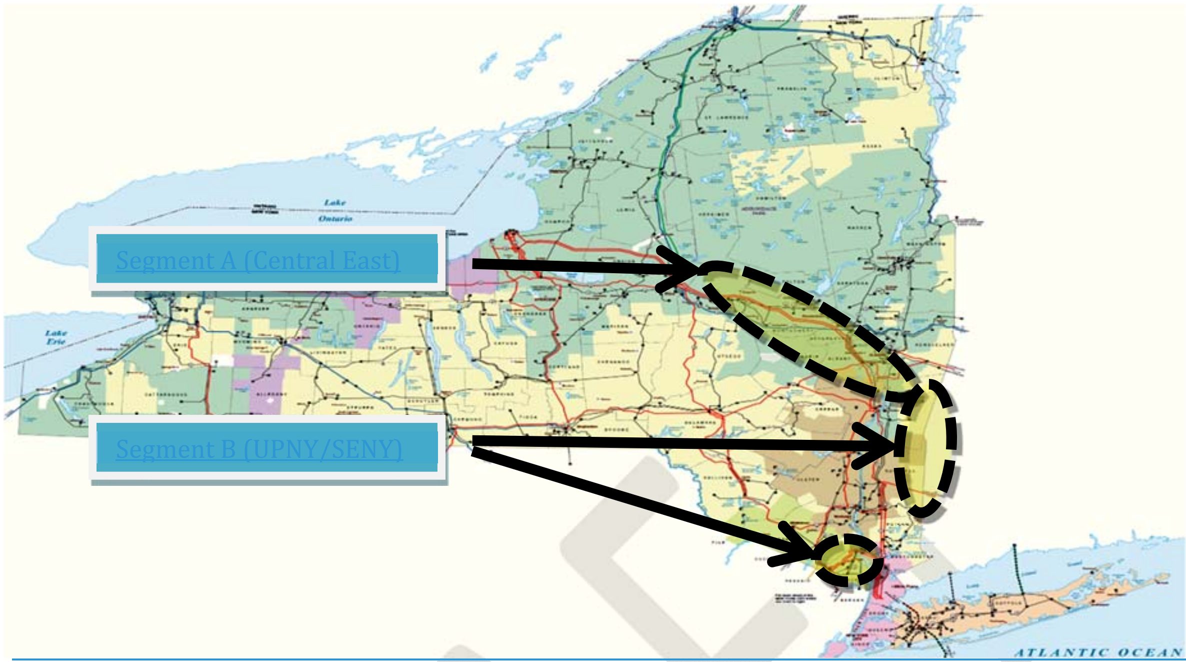
Construction of a new double circuit 138 kV line from Shoemaker to Sugarloaf on existing Shoemaker to Sugarloaf right-of-way; decommissioning of a double circuit 69 kV line from Shoemaker to Sugarloaf; related switching or substation work at Shoemaker, Hartley, South Goshen, Chester, and Sugarloaf.[8]

~~**Figure 2-1: AC Transmission Public Policy Transmission Need**~~



: AC Transmission Public Policy Transmission Needs

[8] December 2015 Order, at Appendix A. With respect to the upgrades to the Rock Tavern substation terminal equipment and the Shoemaker-Sugarloaf facilities, the PSC stated that "all developers should include the upgrade costs in their bids at the same level, and the upgrade costs should not be used as a distinguishing factor between bids." *Id.* at p 62.



The PSC referred the AC Transmission ~~Need~~Needs to the NYISO for solicitation and evaluation of proposed solutions under the NYISO's Public Policy Transmission Planning Process for potential selection in the regional transmission plan for purposes of cost allocation under the OATT. The PSC also prescribed specific evaluation criteria in Appendix B of the December Order, which are set forth in Appendix C of this report, for the NYISO to consider, to the extent feasible, in its evaluation and selection process.

In addition, the PSC identified that the cost allocation methodology for the AC Transmission ~~need~~Needs would be based on a "beneficiaries pay" approach that would allocate the 75 percent of the project costs to economic beneficiaries of reduced congestion and the remaining 25 percent of the project costs across the state based upon load-ratio share.[9] The PSC noted that this methodology will allocate approximately 90 percent of the transmission project's cost to ratepayers in the downstate region. The PSC requested the NYISO to apply its expertise and design a more granular cost allocation among downstate entities consistent with the prescribed methodology.

2.2 Development of Solutions

[9] *Id.* at p 69 & Appendix D.

The NYISO made a presentation at a combined meeting of the Transmission Planning Advisory Subcommittee (TPAS) and Electric System Planning Working Group (ESPWG) on February 5, 2016 to review the PSC's December 2015 Order and the nature of the resulting AC Transmission ~~Need~~Needs.[10] The NYISO then established sufficiency criteria in accordance with the criteria set by the PSC in its December 2015 Order, and made available baseline models and associated Power flow results to aid interested parties in developing project proposals.[11] The PSC specifically prescribed in its December 2015 Order that, in order for a proposed Public Policy Transmission Project or Other Public Policy Project to be considered sufficient by the NYISO, it must satisfy, at a minimum, the following criteria:

- Proposed solutions to Segment A (Central East) must provide at least a 350 MW increase to the Central East interface transfer capability in accordance with Normal Transfer Criteria as defined by the New York State Reliability Council (NYSRC) Reliability Rules.
- Proposed solutions to Segment B (UPNY/SENY) must provide at least a 900 MW increase to the UPNY/SENY interface transfer capability in accordance with Normal Transfer Criteria as defined by the NYSRC Reliability Rules.

Additionally, a sufficient Public Policy Transmission Project must meet the following criteria, as set forth by the December 2015 Order:

- Proposed solutions to Segment A (Central East) must include all project components included in Segment A, as described in the December 2015 Order.
- Proposed solutions to Segment B (UPNY/SENY) must include all project components included in Segment B, as described in the December 2015 Order.
- No acquisition of new permanent transmission rights-of-way, except for *de minimis* acquisitions that cannot be avoided due to unique circumstances; however, the transfer or

[10] The NYISO presentation is posted on its website under meeting materials at the following link: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2016-02-05/03_AC%20Transmission_PPTN.pdf.

[11] The baseline study cases for the AC Transmission ~~Need~~Needs were the same system representation used by the NYISO to perform the evaluation directed by DPS for the Trial Staff Final Report in the Alternating Current Transmission Upgrades proceedings. The baseline study cases were available to all developers, subject to satisfactorily completing a Critical Energy Infrastructure Information (CEII) request, and the base line results are publicly available on the NYISO website at: http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp

lease of existing transmission right-of-way property or access rights from a current utility company owner to a Developer shall not be considered such an acquisition.

- No crossing of the Hudson River, either overhead, underwater, in riverbed, or underground, or in any other way by any component of the transmission facility.
- For those Public Policy Transmission Projects that were also evaluated in the Alternating Current Transmission Upgrades proceedings, the December 2015 Order required that the cost estimate must not exceed the level estimated by the Trial Staff for the project, unless the developer can demonstrate that upward estimates are necessary to correct errors or omissions made by Trial Staff for the components that were added or adjusted by Trial Staff.

For each proposed Public Policy Transmission Project, the PSC required the sponsoring developer to submit at least two project cost estimates. The first cost estimate required the developer to presume that "all prudently incurred costs will be recovered and there will be no sharing of cost overruns."[12] The second cost estimate was required to reflect an 80/20 incentive regime, where if there are actual cost overruns, "the developer shall bear 20% of the cost over-runs, while ratepayers shall bear 80% of those costs[, but if] actual costs come in below a bid, then the developer should retain 20% of the savings," provided that the developer would not seek incentives from FERC above the base return-on-equity otherwise approved.[13]

On February 29, 2016, the NYISO issued a solicitation for proposed solutions of all types (transmission, generation, and demand side) to the AC Transmission ~~Need~~Needs. Following the issuance of the solicitation, the NYISO received numerous questions from interested developers seeking clarification on the process and the AC Transmission ~~Need~~Needs. The NYISO issued a public Frequently Asked Questions (FAQ) document on March 30, 2016, and updated it on April 13, 2016, summarizing the questions and providing responses.[14]

As a result of the solicitation, the NYISO received a total of 16 proposals consisting of both Public Policy Transmission Projects and an Other Public Policy Project. The list of the proposed projects

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12 ~~*See*~~ December 2015 Order, at Appendix C.

13 ~~*See id*~~*Id*.

14 The AC Transmission Public Policy Transmission ~~Need~~Needs FAQ document is available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Public_Policy_Documents/AC_Transmission_PPTN/AC-Transmission_PPTN_FAQ_2016-04-13.pdf.

submitted to the NYISO and considered in the Viability and Sufficiency Assessment are included in

Table **2-1**, below.

Table 2-1: Proposed Projects

Developer	Project Name	Project ID	Category	Type	Location (County/State)
National Grid/Transco	New York Energy Solution Segment A	T018	PPTP	AC	Segment A
National Grid/Transco	New York Energy Solution Segment A	T019	PPTP	AC	Segment B
NextEra Energy Transmission New York	Enterprise Line: Segment A	T021	PPTP	AC	Segment A
NextEra Energy Transmission New York	Enterprise Line: Segment B	T022	PPTP	AC	Segment B
NextEra Energy Transmission New York	Enterprise Line: Segment B-Alt	T023	PPTP	AC	Segment B
North America Transmission / NYPA	Segment A + 765 kV	T025	PPTP	AC	Segment A
North America Transmission / NYPA	Segment A Base	T026	PPTP	AC	Segment A
North America Transmission / NYPA	Segment A Double Circuit	T027	PPTP	AC	Segment A
North America Transmission / NYPA	Segment A Enhanced	T028	PPTP	AC	Segment A
North America Transmission / NYPA	Segment B Base	T029	PPTP	AC	Segment B
North America Transmission / NYPA	Segment B Enhanced	T030	PPTP	AC	Segment B
ITC New York Development	16NYPP1-1A AC Transmission	T031	PPTP	AC	Segment A
ITC New York Development	16NYPP1-1B AC Transmission	T032	PPTP	AC	Segment B
AvanGrid	Connect New York Recommended	T033	PPTP	HVDC	Segments A and B
AvanGrid	Connect New York Alternative	T034	PPTP	HVDC	Segments A and B
GlidePath	Distributed Generation Portfolio	OPP004	OPPP	Gen	Orange, Ulster, Putnam, Greene, NY
PPTP = Public Policy Transmission Project OPPP = Other Public Policy Project		Gen = Generation AC = Alternating Current Transmission HVDC = High-Voltage Direct Current Transmission			

2.3 Viability and Sufficiency Assessment

Through the second and third quarters of 2016, the NYISO assessed the viability and sufficiency of all proposed projects. In conducting its viability and sufficient assessment, the NYISO performed a comparable transfer limit analysis of each project in the same manner as the baseline analysis.[15] Consistent with the PSC's direction that Segment A proposals depend on a Segment B proposal being in place, the NYISO combined each Segment A proposal with each developer's Segment B counterpart proposal. If there was at least one combined case that increased the Central East transfer limit by at least 350 MW, the Segment A proposal met the Central East sufficiency criterion.

The NYISO presented a draft AC Transmission Public Policy Transmission ~~Need~~Needs Viability and Sufficiency Assessment to stakeholders at the joint ESPWG/TPAS on September 26, 2016. After receiving and addressing comments from stakeholders, the NYISO posted on its website the final Viability and Sufficiency Assessment report on October 27, 2016 and filed the same at the PSC in Case No. 14-E-0454 and the Alternative Current Transmission Upgrades proceedings on October 28, 2016.[16] The assessment is included in this report as Appendix B.[17]

In the AC Transmission Public Policy Transmission ~~Need~~Needs Viability and Sufficiency Assessment, the NYISO determined the following projects are viable and sufficient to satisfy the AC Transmission ~~Need~~Needs:

T018: National Grid / Transco – New York Energy Solution Segment A

T019: National Grid / Transco – New York Energy Solution Segment B

T021: NextEra Energy Transmission New York – Enterprise Line: Segment A

T022: NextEra Energy Transmission New York – Enterprise Line: Segment B

[15] On July 29, 2016, the NYISO notified stakeholders and interested parties that although it had acted diligently in administering the current process, it would extend the 2014 cycle of the Public Policy Transmission Planning Process beyond two years as permitted by the OATT. *See* OATT Section 31.4.1.

[16] The NYISO's filing can be obtained at the following link:

http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=12-t0502&submit=Search+by+Case+Number.

[17] The NYISO's "AC Transmission Public Policy Transmission ~~Need~~Needs Viability and Sufficiency Assessment" can be obtained at the following link:

http://www.nyiso.com/public/markets_operations/services/planning/planning_studies/index.jsp.

T023: NextEra Energy Transmission New York – Enterprise Line: Segment B Alt.

T025: North America Transmission / NYPA – Segment A + 765 kV

T026: North America Transmission / NYPA – Segment A Base

T027: North America Transmission / NYPA – Segment A Double Circuit

T028: North America Transmission / NYPA – Segment A Enhanced

T029: North America Transmission / NYPA – Segment B Base

T030: North America Transmission / NYPA – Segment B Enhanced

T031: ITC New York Development – 16NYPP1-1A AC Transmission

T032: ITC New York Development – 16NYPP1-1B AC Transmission

Together with the AC Transmission Public Policy Transmission ~~Need~~Needs Viability and Sufficiency Assessment, the NYISO filed a more granular cost allocation methodology consistent with the prescribed methodology set forth in the December 2015 Order for the PSC's consideration.

2.4 Confirmation of Need for Transmission

On January 24, 2017, following consideration of public comments, the PSC issued an order confirming the AC Transmission ~~Need~~Needs.[18] The January 2017 Order stated that "[t]he Commission agrees that persistent congestion on the Central East and UPNY/SENY interfaces continues to contribute to higher energy costs for downstate customers and to limit the accessibility of renewable resources located upstate," and that the Clean Energy Standard (CES) "further heightens the public policy need for transmission constraint relief and cross-state power flows" allowing renewable resources to be delivered to downstate load centers.[19] Based on the "various economic and public policy benefits," the PSC directed the NYISO to proceed with its evaluation and selection of the proposed transmission solutions deemed viable and sufficient solution that will satisfy the AC Transmission ~~Need~~Needs.

[18] ~~PSC Case No. 12-T-0502, *et al.*,~~ *Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades*, Order Addressing Public Policy Transmission Need for AC Transmission Upgrades, PSC Case Nos. 12-T-0502, *et al.*, (January 24, 2017) ("January 2017 Order").

[19] *Id.* at pp 18-19.

The January 2017 Order also adopted the NYISO's analysis of the recommended cost allocation methodology that the PSC identified as a part of the AC Transmission Public Policy ~~Requirement~~Requirements/Public Policy Transmission ~~Need~~Needs in its December 2015 Order.[20] In response to the PSC's adoption of the NYISO's recommended cost allocation methodology, the NYISO filed, and the FERC accepted, the AC Transmission Cost Allocation methodology.[21]

2.5 Local Transmission Plan Updates and PSC-Directed Upgrades

The PSC, in its December 2015 Order, ordered Orange and Rockland Utilities, Inc. (O&R) and Central Hudson Gas and Electric Corporation (Central Hudson) respectively to upgrade the Shoemaker to Sugarloaf 138 kV facilities and the terminal upgrades at Rock Tavern 345 kV Substation, as part of Segment B project proposals. In its order confirming the AC Transmission ~~Need~~Needs, the PSC determined that the costs of the additional Segment B upgrades should not be a distinguishing factor among project proposals. Accordingly, the NYISO did not include, for each Segment B project, the cost for the additional upgrades for the purpose of evaluation and selection.

[20] *Id.* at p 21. The Commission also reiterated the appropriateness of certain incentives to ensure accurate cost estimates, and encouraged developers to pursue the cost-containment incentives before the Federal Energy Regulatory Commission (FERC) in their rates. *See id.*

[21] *See New York Indep. Sys. Operator, Inc.*, 161 FERC ¶ 61,160 (November 16, 2017). The AC Transmission Cost Allocation methodology is contained in Section 31.8 of Attachment Y to the OATT.

3. Evaluation for Selection of the More Efficient or Cost-Effective Solution

Upon issuance of the January 2017 Order confirming the need for transmission, the NYISO commenced a detailed evaluation of each viable and sufficient transmission proposal with the assistance of its independent consultant, Substation Engineering Company (SECO). This section of the report details the NYISO's evaluation and the results.

3.1 Overview of Proposed Viable and Sufficient Solutions

The NYISO determined that 13 transmission solutions are viable and sufficient. All proposed projects utilize the existing rights-of-way as required by the PSC order. The locations of the proposed projects are shown in Figure 2-1. A brief description and high-level diagram of each of the 13 viable and sufficient projects is provided below, while a detailed description of all project elements is provided in Appendix G of this study report.

3.1.1 Segment A Projects

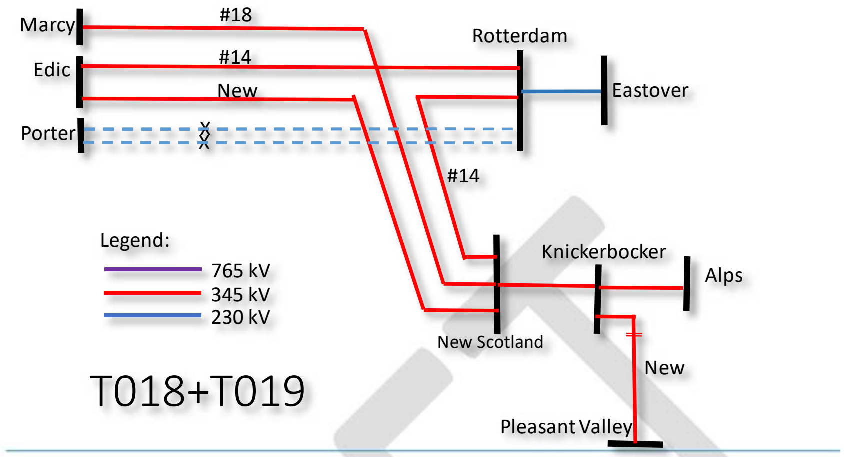
T018: National Grid/Transco - NYES Segment A

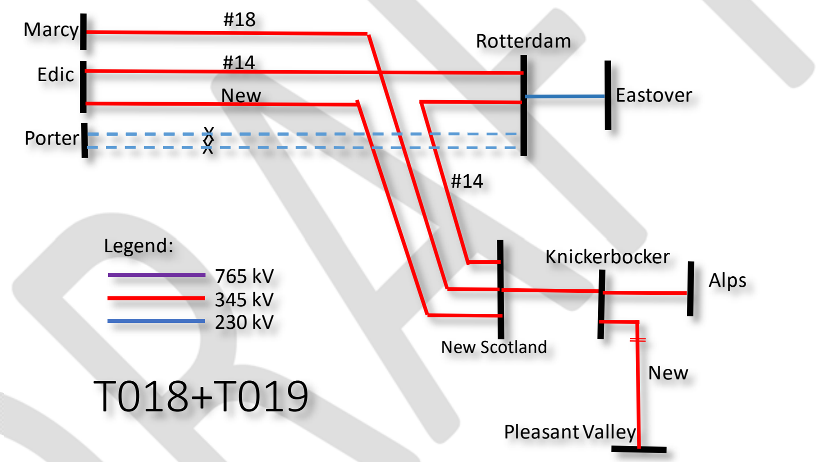
National Grid/Transco's NYES Segment A Proposal includes the following components:

- A new 345 kV line of approximately 87 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation. The New Scotland 345kV Substation will be upgraded and expanded
- Two new 345 kV lines of approximately ~~5~~five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV autotransformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard
- One new 345/230 kV autotransformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard
- One new 135 MVAR capacitor bank connected to the new Rotterdam 345 kV switchyard
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-1 shows the one-line diagram of T018 (together with components of T019).

Figure 3-1: ~~One-Line~~High-Level Diagram of T018+T019





T021: NextEra - Enterprise Line Segment A

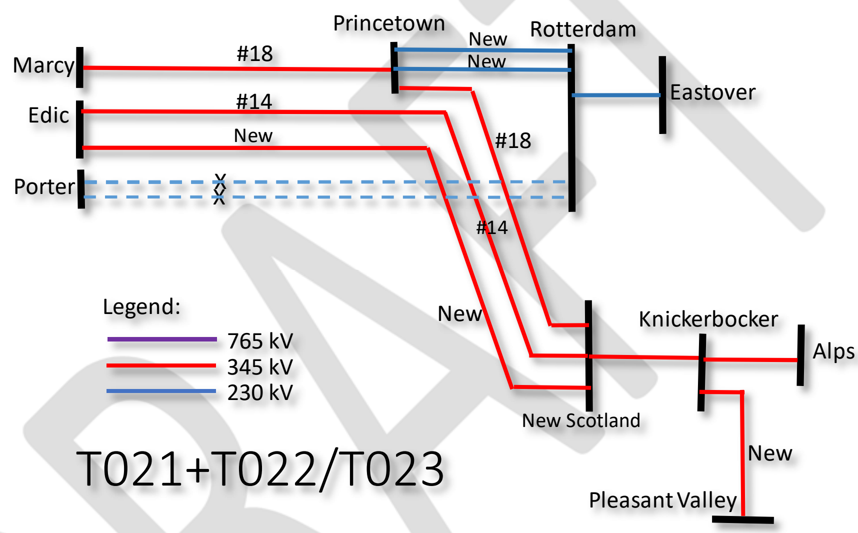
NextEra's Enterprise Segment A Proposal includes the following components:

- A new 345 kV line of approximately 86 miles (83.4 miles 345 kV line and 2.6 miles double circuit 345/115 kV line) from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Rebuild 2.6 miles of existing Rotterdam-New Scotland 115 kV line circuit #13
- A new breaker-and-a-half 345/230 kV Princetown Substation, located near the existing Rotterdam 230 kV substation. The substation will include two 345/230 kV auto-transformers

- Two new 345 kV circuits each approximately ~~4~~four miles in length to loop the existing Marcy – New Scotland 345 kV circuit #18 into Princetown 345/230 kV substation
- Two new ~~1~~one mile 230 kV lines from Princetown-Rotterdam
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-2 shows the one-line diagram of T021 (together with components of T022/T023).

Figure 3-2: ~~One-Line~~High-Level Diagram of T021+T022/T023



T025: NAT/NYPA - Segment A + 765 kV

The NAT/NYPA Segment A +765 kV Proposal consists of the following components:

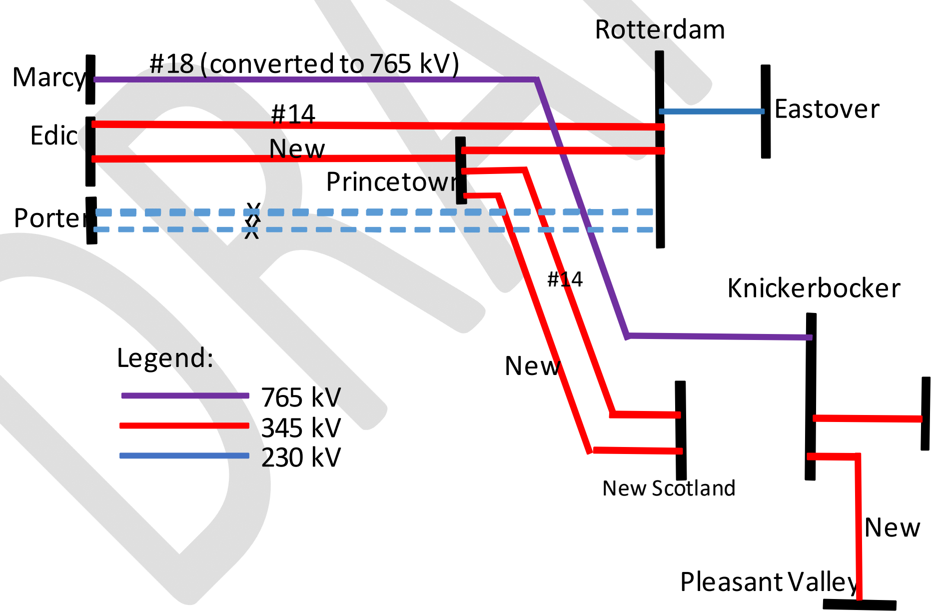
- A new 345 kV line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Two new 345 kV lines of approximately ~~5~~five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV lower impedance transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV

switchyard

- A new Princetown 345kV switchyard by tapping the newly proposed Edic-New Scotland lines and Rotterdam-New Scotland transmission lines
- Convert the Marcy – New Scotland and New Scotland – Knickerbocker 345 kV transmission lines to 765 kV operation as Marcy – Knickerbocker 765 kV (with no connection at New Scotland)
- Switching station or substation work at Knickerbocker with two new 2000 MVA 765/345 kV transformers at Knickerbocker
- Terminal upgrades at Edic and Marcy 345 kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-3 shows the one-line diagram of T025 (together with components of T029/T030).

Figure 3-3: ~~One-Line~~High-Level Diagram of T025+T029/T030



T026: NAT/NYPA - Segment A Base

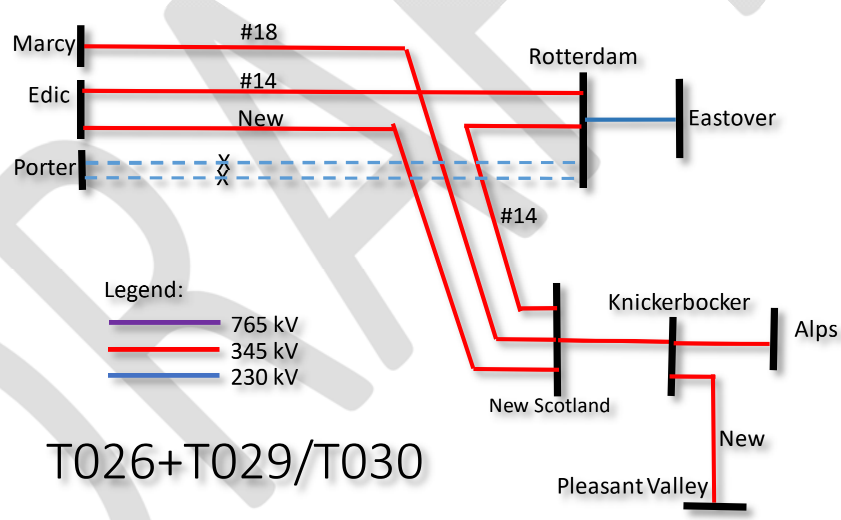
NAT/NYPA Segment A Base Proposal consists of the following components:

- A new 345 kV line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation

- Two new 345 kV lines of approximately ~~5~~five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard
- Terminal upgrades at Edic and Marcy 345kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-4 shows the one line diagram of T026 (together with components of T029/T030).

Figure 3-4: ~~One-Line~~High-Level Diagram of T026+T029/T030



T027: NAT/NYPA - Segment A Double-Circuit

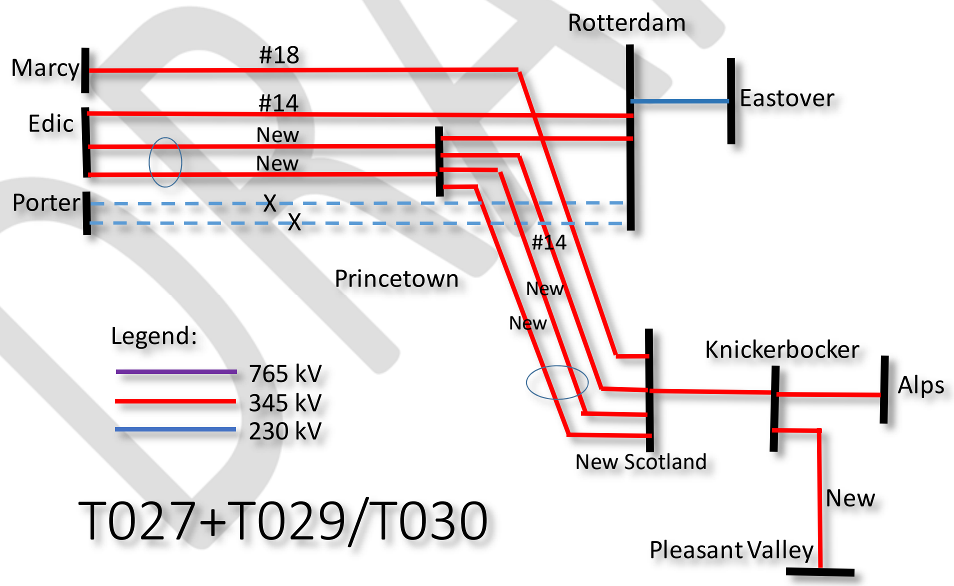
NAT/NYPA Segment A Double Circuit Proposal consists of the following components:

- A new 345 kV double circuit line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation
- Two new 345 kV lines of approximately ~~5~~five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired

- Two new 345/115 kV lower impedance transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard
- Rebuild approximately ~~6~~six miles of the Rotterdam to New Scotland 345 kV transmission line to accommodate the new double-circuit line beginning from Princetown junction
- Remove the Rotterdam to New Scotland 115 kV transmission line
- A new Princetown 345 kV switchyard by tapping the newly proposed Edic-New Scotland lines and Rotterdam-New Scotland transmission lines
- Terminal upgrades at Edic and Marcy 345 kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-5 shows the one-line diagram for T027 (together with components of T029/T030).

Figure 3-5: ~~One-Line~~High-Level Diagram of T027+T029/T030



T028: NAT/NYPA - Segment A Enhanced

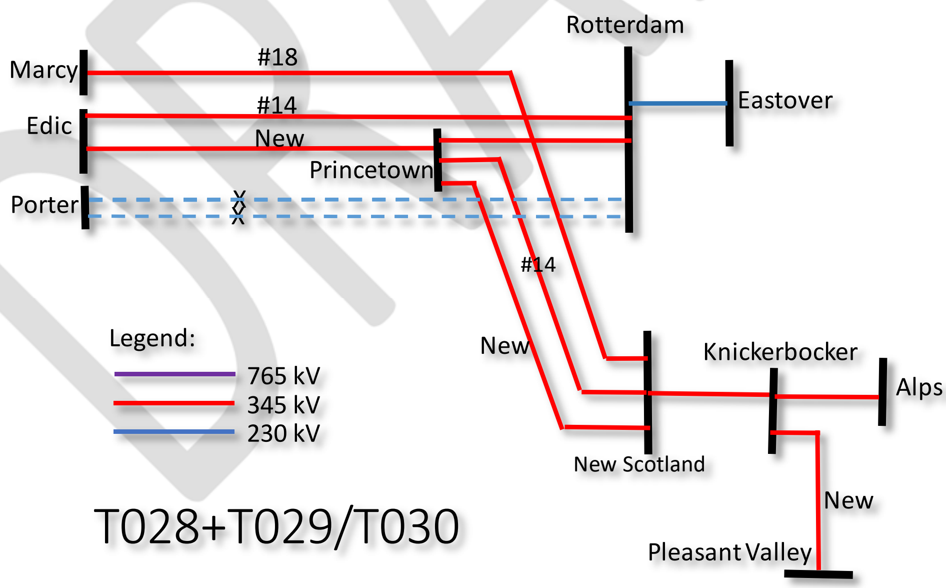
The NAT/NYPA - Segment A Enhanced Proposal consists of the following components:

- A new 345 kV line of approximately 86 miles from the existing Edic 345 kV substation to the existing New Scotland 345 kV substation

- Two new 345 kV lines of approximately ~~5~~five miles single-circuit looping the existing 345 kV Edic to New Scotland #14 line into and out of a new Rotterdam 345 kV Substation. The Rotterdam 230 kV substation will be retired
- Two new 345/115 kV lower impedance transformers connecting the existing Rotterdam 115 kV switchyard to the new 345 kV switchyard. One new 345/230 kV transformer connecting the existing 230 kV Rotterdam to Eastover Road #38 line to the new Rotterdam 345 kV switchyard
- A new Princetown 345 kV switchyard by tapping the newly proposed Edic-New Scotland lines and Rotterdam-New Scotland transmission lines
- Terminal upgrades at Edic and Marcy 345 kV substations
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-6 shows the one-line diagram of T028 (together with components of T029/T030).

Figure 3-6: ~~One-Line~~High-Level Diagram of T028+T029/T030



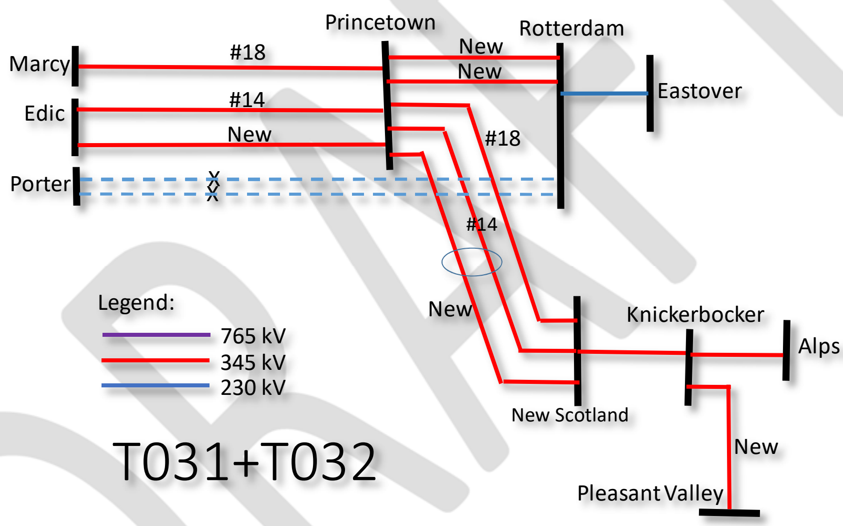
T031: ITC - 16NYPP1-1A AC Transmission Segment A

The ITC Segment A Proposal consists of the following components:

- A new Princetown 345 kV switching station tapping the existing Marcy to New Scotland 345 kV #18 line and Edic to New Scotland 345 kV #14 line
- A new Edic – Princetown – New Scotland 345 kV line, rebuilding line #14 between Princetown and New Scotland and sharing the common tower structures with the new line
- A new Rotterdam 345 kV substation with two new 345/230 kV transformers
- Two new Princetown to Rotterdam 345 kV lines of approximately 5.2 miles single circuit
- Decommission of the Porter to Rotterdam 230 kV lines #30 and #31

Figure 3-7 shows the one-line diagram of T031 (together with components of T032).

Figure 3-7: ~~One-Line~~High-Level Diagram of T031+T032



3.1.2 Segment B Projects

All Segment B projects include the common upgrades required by the PSC in its December 2015 Order, which ordered Orange and Rockland Utilities, Inc. (O&R) and Central Hudson Gas and Electric Corporation (Central Hudson) respectively to upgrade the Shoemaker to Sugarloaf 138 kV facilities and the terminal upgrades at Rock Tavern 345 kV Substation, as part of Segment B projects.

T019: National Grid/Transco - NYES Segment B

National Grid/Transco-NYES Segment B proposal consists of the following components:

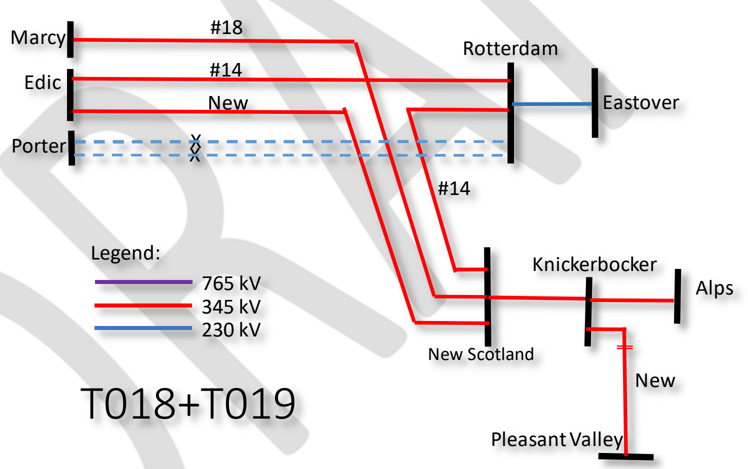
- A new double-circuit 345/115 kV line from a new Knickerbocker 345 kV Switching Station to the existing Pleasant Valley Substation, including a rebuild of the Churchtown 115 kV

Switching Station and an upgrade of the existing Pleasant Valley 345/115 kV Substation, and 50% series compensation on Knickerbocker to Pleasant Valley 345 kV line

- Two new 135 MVAR 345 kV capacitor banks connected to the Pleasant Valley 345 kV Substation
- Terminal upgrades to the existing Roseton 345 kV Substation and Transition Station to upgrade the thermal ratings on the 345 kV Roseton to East Fishkill #305 line
- Terminal upgrades to the existing New Scotland 345 kV Substation to upgrade the thermal ratings on the 345 kV New Scotland to Knickerbocker #2A line
- Retirement of aging infrastructure including multiple existing 115 kV lines between Greenbush 115 kV Substation and Pleasant Valley 115 kV Substation

Figure 3-8 shows the one-line diagram of T019 (together with components of T018).

Figure 3-8: ~~One-Line~~High-Level Diagram of T018+T019



T022: NextEra - Enterprise Line Segment B

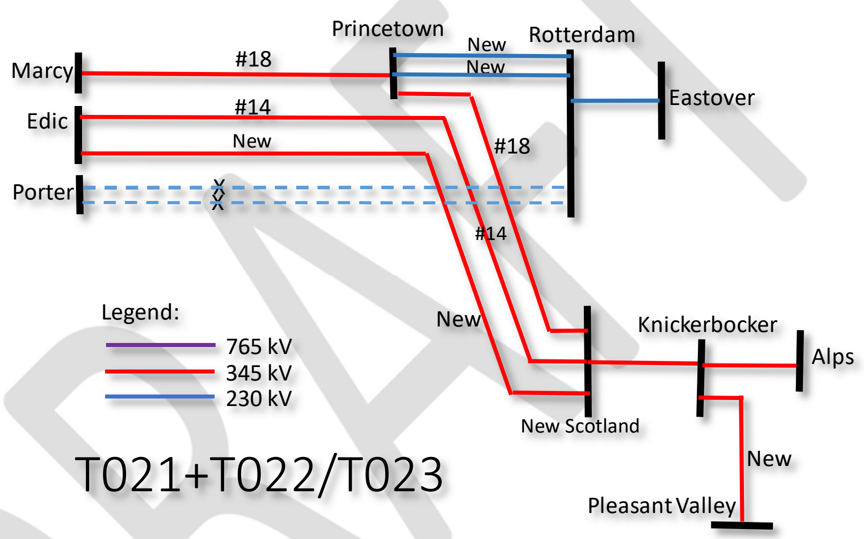
NextEra Enterprise Line Segment B proposal consists of the following components:

- Multiple retirements and reconfigurations on 115 kV lines between Greenbush – Pleasant Valley
- New Knickerbocker 345 kV Switchyard, approximately 13 miles southeast of New Scotland along the New Scotland - Alps 345 kV line

- Loop New Scotland - Alps 345 kV line circuit #2 into Knickerbocker Switchyard
- New North Churchtown 115 kV Switchyard, just north of NYSEG's existing Churchtown 115 kV switchyard
- A new 345 kV line from a new Knickerbocker 345 kV switching station to the existing Pleasant Valley 345 kV substation (double-circuit 345/115 kV line between Knickerbocker and Churchtown, and single–circuit 345 kV line between Churchtown and Pleasant Valley)

Figure 3-9 shows the one-line diagram of T022 (together with components of T021).

Figure 3-9: ~~One-Line~~High-Level Diagram of T022



T023: NextEra - Enterprise Line Segment B-Alt

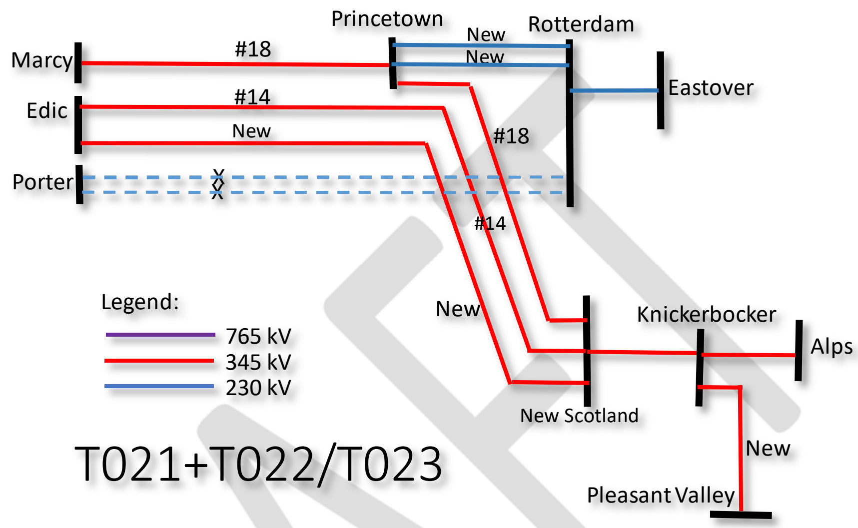
NextEra Enterprise Line Segment B-Alt proposal consists of the following components:

- Multiple retirements and reconfigurations on 115 kV lines between Greenbush – Pleasant Valley
- New Knickerbocker 345 kV Switchyard, approximately 13 miles southeast of New Scotland along the New Scotland - Alps 345 kV line
- Loop New Scotland - Alps 345 kV line circuit #2 into Knickerbocker Switchyard
- New North Churchtown 115 kV Switchyard, just north of NYSEG's existing Churchtown 115 kV switchyard

- A new double-circuit 345/115 kV line from a new Knickerbocker 345 kV switching station to the existing Pleasant Valley 345 kV substation

Figure 3-10 shows the one-line diagram of T023 (together with components of T021).

Figure 3-10: ~~One-Line~~High-Level Diagram of T023



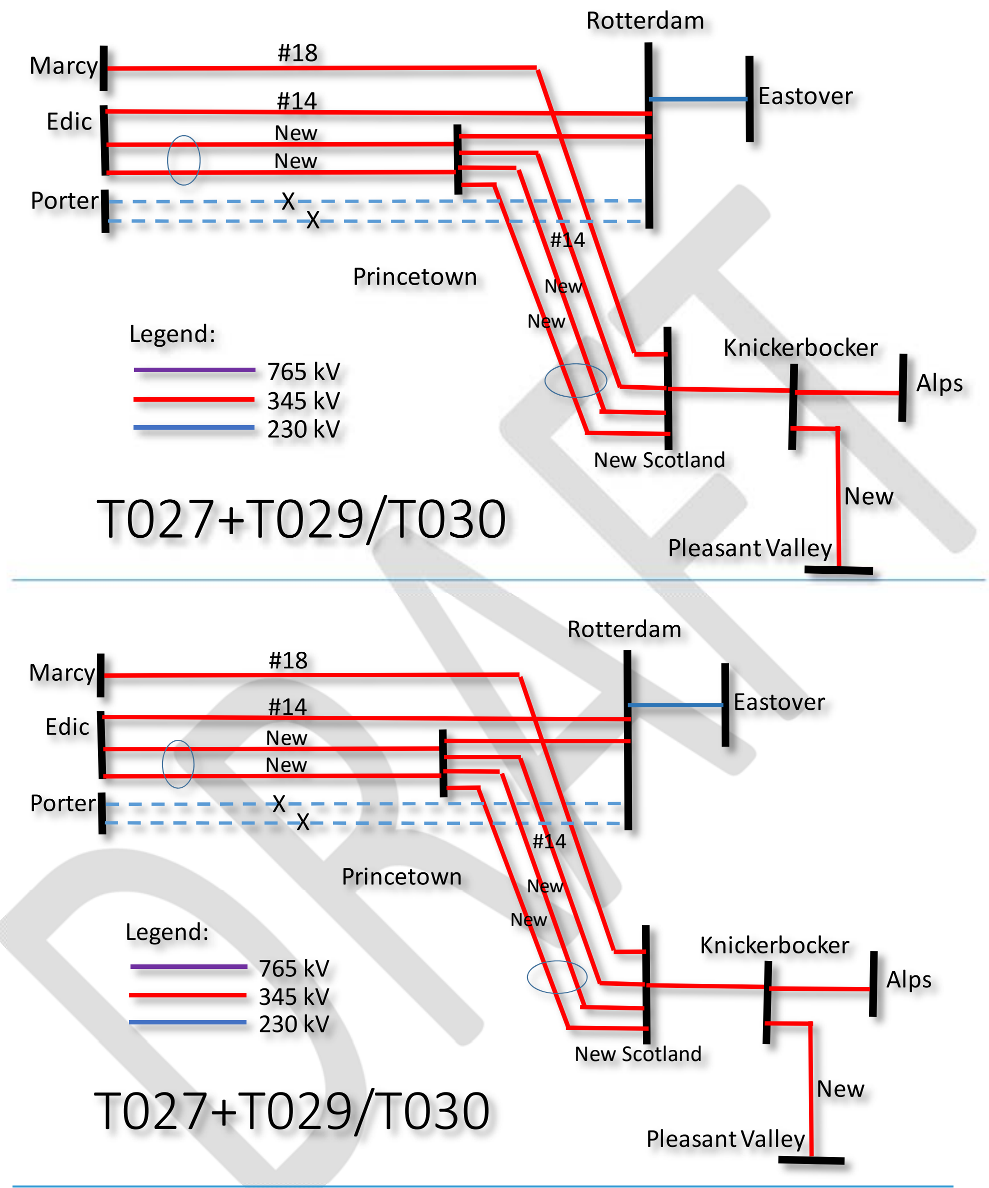
T029: NAT/NYPA - Segment B Base

NAT/NYPA Segment B Base Proposal consists of the following components:

- Multiple retirements and reconfigurations on 115 kV lines between Greenbush – Pleasant Valley
- A new 345 kV Knickerbocker switchyard along the New Scotland - Alps 345 kV line
- Loop the existing 345 kV New Scotland to Alps transmission line into Knickerbocker Switchyard
- A new double-circuit 345/115 kV line from a new Knickerbocker 345 kV switching station to Pleasant Valley 345 kV substation (double-bundled 345 kV line)
- A new Churchtown 115 kV substation
- Shoemaker – Shoemaker Tap – Middletown 345/138 kV transformer and 138 kV facilities upgrades

Figure 3-11 shows the one-line diagram of T029 (together with components of T027).

Figure 3-11: ~~One-Line~~High-Level Diagram of T027+T029/T030

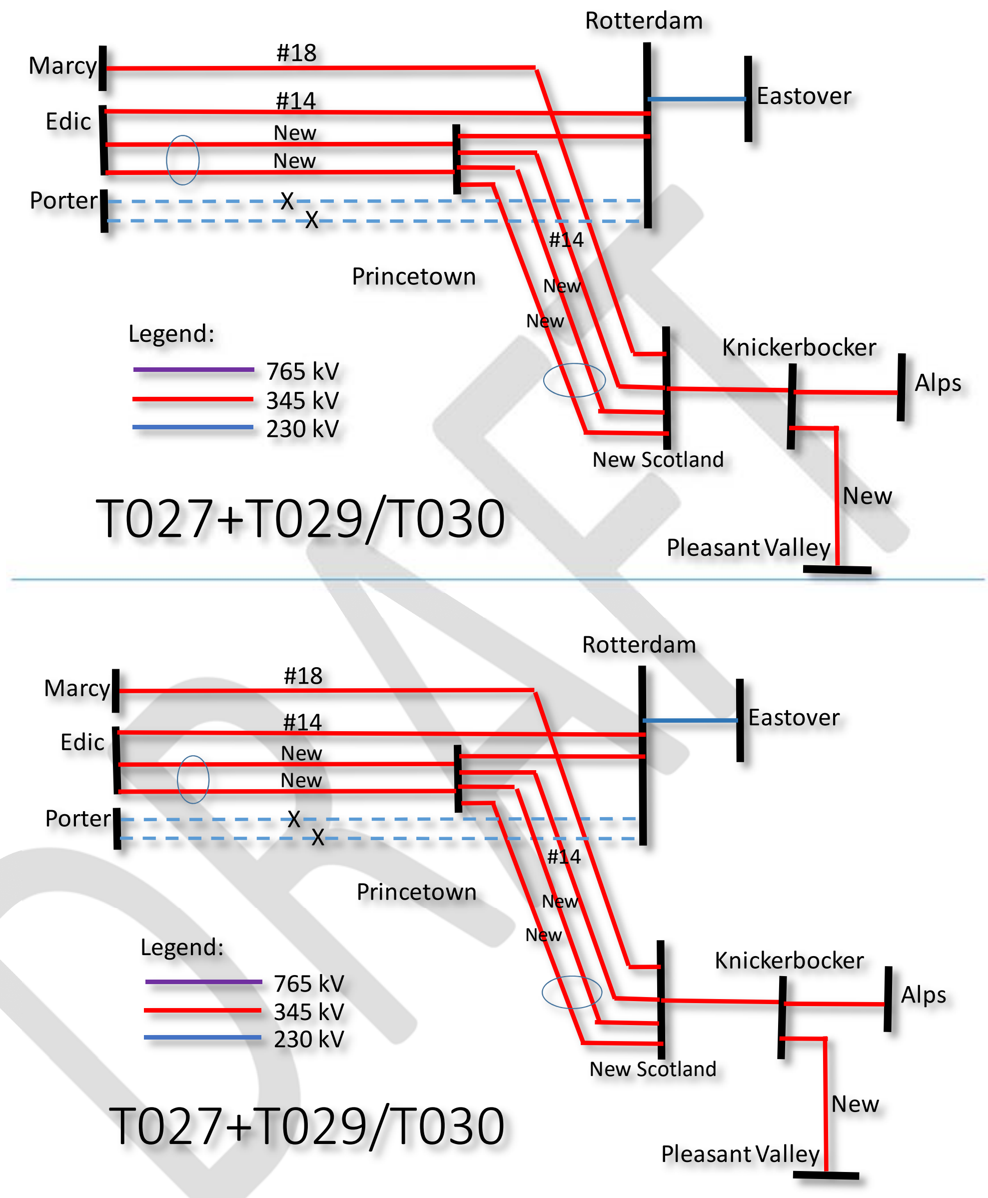


T030: NAT/NYPA - Segment B Enhanced

NAT/NYPA Segment B Enhanced Proposal consists of the components included with the Segment B Base Proposal with use of a triple bundle (instead of double bundle) conductor for the Knickerbocker – Pleasant Valley 345 kV transmission line.

Figure 3-12 shows the one-line diagram of T030 (together with components of T027).

Figure 3-12: ~~One-Line~~High-Level Diagram of T027+T029/T030



T032: ITC - 16NYPP1-1A AC Transmission Segment B

ITC Segment B Proposal consists of the following components:

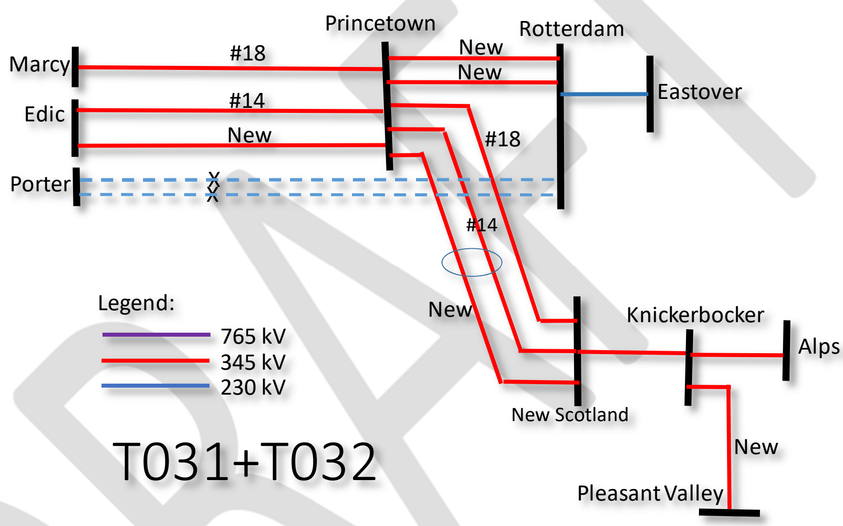
- Multiple retirements and reconfigurations on 115 kV lines between Greenbush and Pleasant Valley
- A new Knickerbocker 345~~/115~~ kV ~~substation~~Substation and a new Knickerbocker115 kV

Substation by tapping the existing 345 kV New Scotland to Alps circuit and Greenbush to Pleasant Valley 115 kV ~~line~~lines respectively

- A new 345/115 kV double-circuit line from the Knickerbocker station to Churchtown station on existing Greenbush to Pleasant Valley right-of-way
- A new 345/115/115 kV triple-circuit line from Churchtown to Pleasant Valley on existing Greenbush to Pleasant Valley right-of-way

Figure 3-13 shows the one-line diagram of T032 (together with components of T031).

Figure 3-13: ~~One-Line~~High-Level Diagram of T031+T032



3.1.3 Project Combinations

Consistent with the PSC's direction that no Public Policy Transmission Project shall be selected for Segment A unless a Public Policy Transmission Project is selected for Segment B, the NYISO combined each Segment A proposal with each developer's Segment B counterpart proposal. In order to evaluate a feasible number of possible combinations between Segment A and Segment B proposals, the NYISO developed combinations of projects that are representative of the electrical characteristics of all the proposed viable and sufficient transmission projects, as follows:

- Combining all Segment A and Segment B projects from the same developers, and
- Combining Segment A and Segment B projects from different developers based on combinations with similar electrical characteristics.

Initial Segment A grouping:

- Similar Segment A projects: T018, T021, T026, T028, T031
- Segment A: T025
- Segment A: T027

Initial Segment B groupings:

- Similar Segment B projects: T022, T023, T029, T030, T032
- Segment B: T019

Table 3-1 shows the complete list of the representative combinations that were studied by the NYISO, and **Table 3-2** shows how to apply the representative results to the combinations that were not explicitly studied.

Table 3-1: Representative Combinations

Combination ID	Representative Combination
1	T018+T019
2	T021+T022
3	T021+T023
4	T025+T019
5	T025+T029
6	T025+T030
7	T026+T029
8	T026+T030
9	T027+T019
10	T027+T029
11	T027+T030
12	T028+T029
13	T028+T030
14	T031+T032

Table 3-2: Representative Results Based on Combination ID

Representative Results for Central East Voltage Transfer and Production Cost Analysis

	T018	T021	T025	T026	T027	T028	T031
T019	1	3	4	7	9	12	14
T022	1	2	5	7	10	12	14
T023	1	3	5	7	10	12	14
T029	1	3	5	7	10	12	14
T030	1	3	6	8	11	13	14
T032	1	3	5	7	10	12	14

Representative Results for UPNY/SENY Thermal Transfer

	T018	T021	T025	T026	T027	T028	T031
T019	1	1	4	1	9	1	1
T022	2	2	5	2	10	2	2
T023	3	3	5	3	10	3	3
T029	7	7	5	7	10	12	12
T030	8	8	6	8	11	13	13
T032	14	14	5	14	10	14	14

3.2 Overview of Evaluation Assumptions

The process for the evaluation of solutions is described in the NYISO Public Policy Transmission Planning Process Manual, and evaluates the metrics set forth in the NYISO's tariff and, to the extent feasible, the criteria prescribed by the PSC. Notably, the NYISO's evaluation of Public Policy Transmission Projects differs from its evaluation of projects in its other planning processes because it can give varying levels of considerations to the baseline and the chosen scenarios based upon the nature of the proposed Public Policy Transmission Projects. In other words, certain projects may perform differently under normal operating conditions (*i.e.*, the baseline) and other potential operating conditions. Based upon the particulars of the Public Policy Transmission Need, the more efficient or cost-effective solution may be chosen based upon a scenario or a combination of scenarios and the baseline cases.

Three major types of analysis were conducted in evaluating quantitative metrics: transfer limit analysis, resource adequacy analysis, and production cost simulation. The study method, assumptions, and the metrics evaluated by the study method are described in the following sections. The results of these analyses are described in Section 3.3.

3.2.1 Transfer Limit Analysis

Transfer limit analysis evaluates the amount of power that can be transferred across an interface while observing applicable reliability criteria. The results of transfer limit analysis were used in the evaluation of metrics such as cost per MW, operability, and expandability. Based on the criteria set forth by the NYPSC Order, the NYISO determined that a power flow model is necessary to evaluate the transfer limits of the Central East and UPNY/SENY interfaces.

The Central East interface represents transmission lines from Utica to Albany and a line from northern New York to Vermont. Central East is typically a voltage-constrained interface; therefore, the NYISO performed a voltage transfer analysis using the PowerGEM TARA software and in accordance with the NYISO Guideline for Voltage Analysis and Determination of Voltage-Based Transfer Limits. To determine the voltage transfer limits, the NYISO created a set of power flow cases with increasing transfer levels by increasing generation upstream of the interface and decreasing generation downstream of the interface. As the transfer level across the interface was increased, the voltage-constrained transfer limit was determined to be the lower of: (1) the pre-contingency power flow at which the pre/post-contingency voltage falls below the voltage limit criteria, or (2) 95% of the pre-contingency power flow at the voltage collapse point, also known as the "tip of the nose" of the post-contingency power-voltage (PV) curve.

The UPNY~~-~~/SENY interface represents a collection of transmission lines on which power flows from Upstate New York to Southeast New York. UPNY/SENY is historically limited by the thermal capability of the individual transmission lines; therefore, the NYISO performed the thermal transfer analysis for the interface in accordance with the Normal Transfer Criteria as defined by the New York State Reliability Council (NYSRC) Reliability Rules. The NYISO used the PowerGEM TARA program to perform the thermal transfer analysis. To determine the thermal transfer limits, the NYISO raised the power flow across the interface by uniformly increasing upstream generation and uniformly decreasing downstream generation. The long-term emergency (LTE) ratings of the BPTF were monitored while simulating design contingency events. During transfer analysis, the NYISO also monitored all 100 kV and above facilities that are not BPTF. Whenever the post contingency power flow on the non-BPTF exceeded short-term emergency (STE) ratings, the NYISO evaluated whether the loss of the non-BPTF would cause other facilities to be overloaded. If the affected facility's loss caused other non-BPTF to exceed their STE ratings or BPTF to exceed their LTE ratings (consistent with the NYSRC Reliability Rules and Exceptions), the NYISO determined a transfer limit that would allow the system to operate without the loss of multiple transmission facilities.

3.2.1.1 Baseline Transfer Analysis

For purposes of evaluating the proposed solutions, the NYISO performed a baseline transfer analysis starting with the power flow cases that were used in the 2016 Reliability Planning Process[22] (2016 RPP) base case system representation of 2026 summer peak load to determine the performance of the AC Transmission Public Policy Transmission Projects. These 2016 RPP power flow base cases were then updated with the latest information from the 2017 Load and Capacity Data Report. Some of these ~~includes~~updates include generation additions such as Ginna, FitzPatrick, Cayuga, CPV Valley Energy Center, Cricket Valley Energy Center, Bayonne Energy Center II, and Bethlehem Energy Center Up-rate. Other updates include retirement of the Indian Point Energy Center Units No. 2 & 3 and inclusion of Empire State Line, which the NYISO selected to satisfy Western New York Public Policy Transmission ~~need in the system topology.~~Need. Generic upgrades were also ~~added in the transfer analysis scenario~~included for the underlying ~~Chester -~~ Shoemaker - Sugarloaf

[22] The 2016 Reliability Needs Assessment is posted at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Reliability_Planning_Studies/Reliability_Assessment_Documents/2016RNA_Final_Oct18_2016.pdf.

area as directed by the ~~NYPSC~~PSC Order. The baseline transfer analysis scenario considered two Roseton dispatches~~,~~ —one with Roseton dispatched at 100% of its capacity and another with Roseton dispatched at 85% of its capacity. The 2016 RPP base case modeled the Marcy South Series Compensation as in-service. The Hudson Transmission Project (HTP) was scheduled at 0 MW based on its cancellation of Firm Transmission Withdrawal Rights in PJM. Operational Base Flow (OBF) was not scheduled on the ABCJK PARs based on the expected expiration ~~of the NYISO-PJM Joint Operating Agreement~~in October 2019.

3.2.1.2 Viability and Sufficiency Assessment Transfer Analysis

This report also included the transfer analysis performed during the Viability and Sufficiency Assessment in 2016. This transfer analysis was based on the power flow cases from the NYISO 2014 Reliability Planning Process base case system representation of the 2019 summer peak load, modified to include the CPV Valley Energy Center generation plant and associated System Deliverability Upgrades. Appendix B describes the detailed assumptions used in the Viability and Sufficiency Assessment.

3.2.2 Resource Adequacy Analysis

Resource adequacy is the ability of the electric systems to supply the aggregate electricity demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system elements. The New York Control Area (NYCA) is planned to meet a Loss of Load Expectation (LOLE) that, at any given point in time, is less than or equal to an involuntary load disconnection that is not more frequent than once in every 10 years, or 0.1 events per year. The purpose of resource adequacy analysis for the AC Transmission ~~Need~~Needs was not intended to identify any reliability needs, but to 1) make sure the MAPS database has enough resources in the comparative evaluation, and 2) set up the MARS database for the ICAP benefit analysis.

The NYISO performed a baseline resource adequacy evaluation of the NYCA for the AC Transmission ~~Need~~Needs. The 2016 RPP base cases were used as a starting point and the NYCA load forecast was extended up to year 2046 to cover the study period. The generation and transmission assumptions ~~are~~were the same as those used by the NYISO ~~used~~ in the baseline transfer analysis. Consistent with the MARS topology proposed for the 2018 RNA,[23] the pre-project UPNY-ConEd

[23] *See* 2018 RNA Preliminary Topology Presentation, http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2018-03-13/2018RNA_Preliminary Topology.pdf

transfer limit was increased to 6,250 MW, and the pre-project UPNY-/SENY topology was updated with dynamic limits. For comparative evaluation purpose, MARS topology was also developed for AC Transmission projects based on transfer analysis.

LOLE analysis was also performed for a scenario modeling the Clean Energy Standard (CES) and retirement of aging generation. (CES + Retirement). The assumptions used for this scenario are described in Section 3.2.3.2.3, and the MARS topology is the same ~~as~~that the NYISO used in the baseline resource adequacy analysis.

If any potential NYCA LOLE violations were identified in the analysis, compensatory MW were added to NYCA zones to resolve the LOLE violations. The compensatory MW amounts and locations were determined based on a review of binding interfaces and zonal LOLE levels in an iterative process to address the LOLE violations. The compensatory MWs were added over the study years, and Table 3-3 below shows the cumulative compensatory MW that needs to be added to satisfy the LOLE criterion of 0.1 events per year.

Table 3-3: Cumulative Compensatory MW ~~in~~by 2042

	Project	Zone C	Zone H	Zone J	Zone K	Total
Baseline	Pre-Project	-	500	550	350	1400
	Combinations involving T018, T025, or T027	250	250	450	350	1300
	Other Combinations	250	250	500	350	1350
CES+ Retirement	Pre-Project	-	-	1450	550	2000
	Combinations involving T018, T025, or T027	-	-	1150	550	1700
	Other Combinations	-	-	1250	550	1800

3.2.3 Production Cost Analysis

Production cost analysis evaluated the proposed Public Policy Transmission Projects and their impact on NYISO wholesale electricity markets. The results of production cost analysis were used in the evaluation of metrics such as production cost savings, production cost saving/project cost ratio, system CO_2 emission reduction, LBMP, load payment, and performance.

3.2.3.1 Baseline Analysis

The AC Transmission ~~Need~~Needs production cost analysis baseline case was derived from the draft 2017 CARIS Phase 1 database.[24] Updates were made to the system while extensions were made for increasing the range of the study period (2017 – 2046). At the November 17, 2017 ESPWG/TPAS meeting, the NYISO presented the starting database, updates, and extensions for the baseline production cost analysis.[25] The generation and transmission assumptions are the same as used in the power flow baseline.

Due to the longer study period of the AC Transmission baseline case, the load, fuel, and emissions forecasts were extended. While the fuel and emissions forecasts would affect the four-pool system in the Northeast (IESO, ISO-NE, NYISO, and PJM), the NYISO ~~was able to model~~ modeled the load forecast extensions only for the ~~NYISO. Load forecasts for the external control areas only range from 2017 to 2026 consistent~~New York Control Area. Consistent with the CARIS methodology~~. Therefore, after 2026~~, the NYISO held external control area loads fixed to the 2026 ~~schedule~~level for 2027 through 2046. The baseline also modeled a national CO_2 program starting in 2027.

3.2.3.2. Scenario Analysis

At the November 17, 2017 ESPWG meeting, the NYISO solicited from stakeholders the potential scenarios for evaluating the AC Transmission Public Policy Transmission Projects. Based on stakeholder feedback, the NYISO developed scenarios by modifying the baseline assumptions to evaluate the robustness of the proposed Public Policy Transmission Projects according to the selection metrics and the impact on NYISO wholesale electricity markets. The following sections describe the scenarios that assist in understanding the overall performance of the projects under various conditions.

3.2.3.2.1. Scenario #1: National CO_2 removed

The baseline modeled a national CO_2 program starting from 2027. The NYISO developed Scenario #1 ~~assuming the~~, which assumes that a national CO_2 program is not in place.

3.2.3.2.2. Scenarios #2 and #3: High fuel and low fuel

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[24] 2017 CARIS Phase 1 assumptions and results are posted at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic/meeting_materials/2018-03-15/2017_Report_CARIS2017_final_draft_031518_BIC.pdf.

[25] The meeting materials are posted at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2017-11-17/AC_Transmission_Ph2_Assumptions.pdf.

The NYISO also developed high and low fuel costs for the baseline consistent with the fuel forecast methodology used in the CARIS process. Energy Information Administration's Annual Energy Outlook forecasts of the annual national delivered price were used to generate Low and High natural gas price forecasts for each region. ~~and show the high and low natural gas forecast used in these scenarios.~~

Figure 3-14: **Baseline** **Natural Gas Forecast**

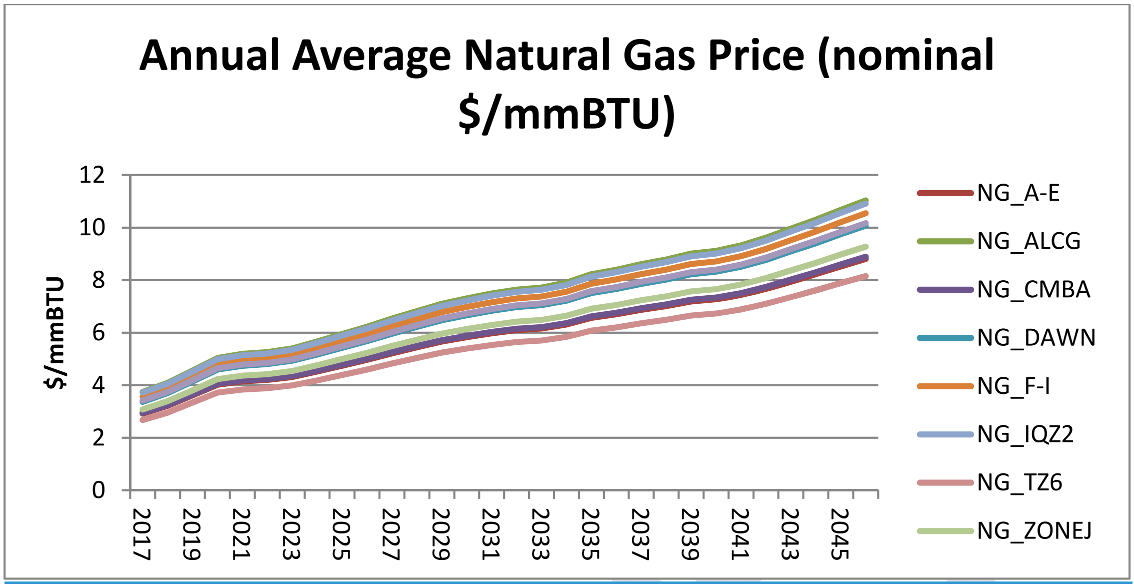
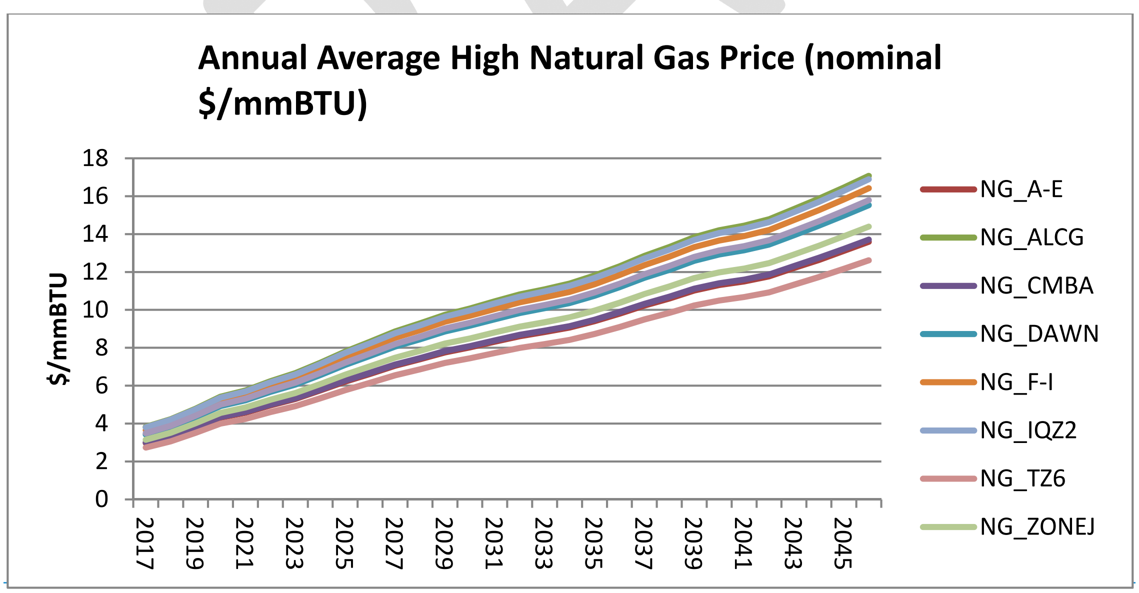


Figure 3-15, Figure 3-16, and Figure 3-16 show the baseline, high, and low natural gas forecasts used in these scenarios.

Figure 3-14: ~~High~~Baseline Natural Gas Forecast



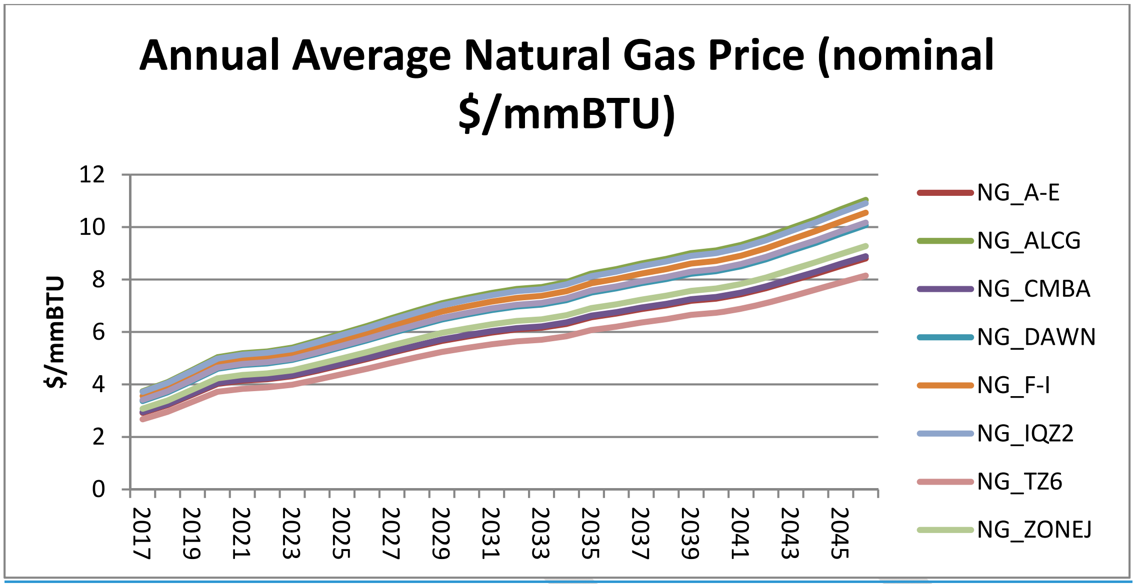


Figure 3-15: High Natural Gas Forecast

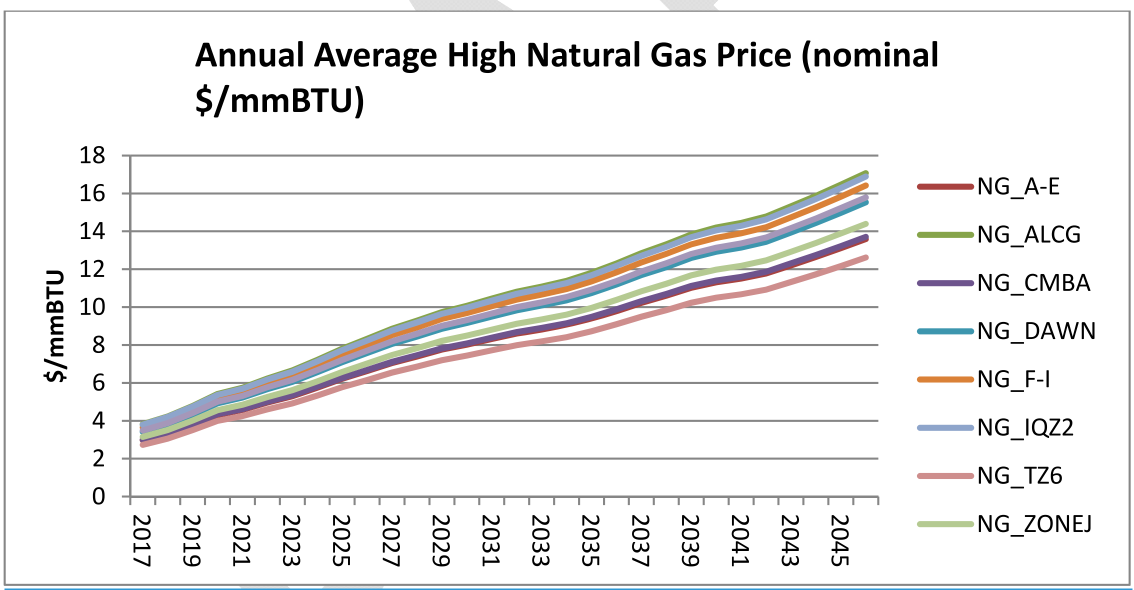
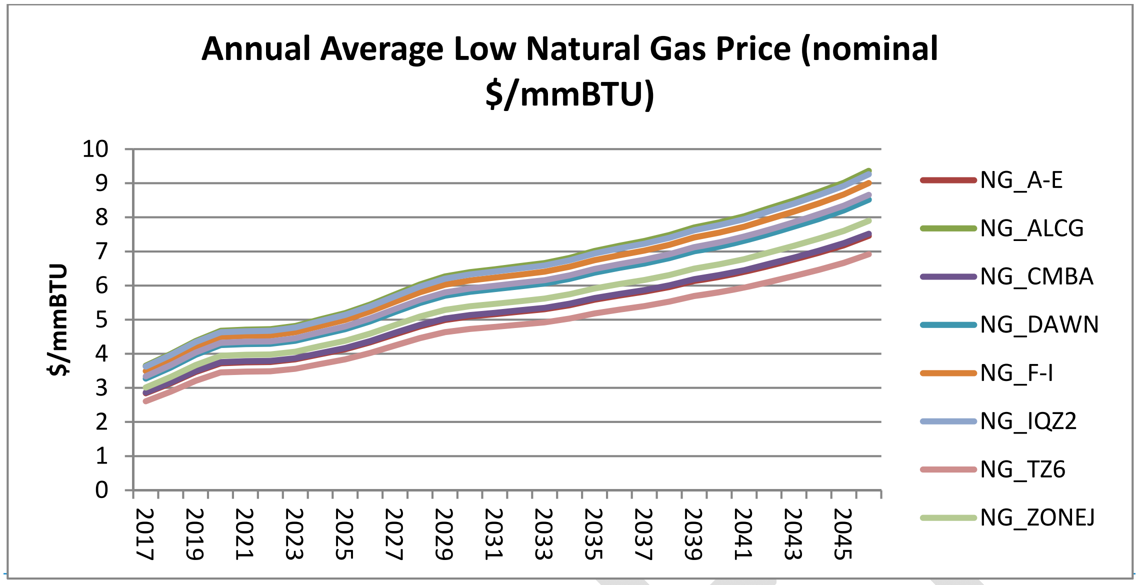
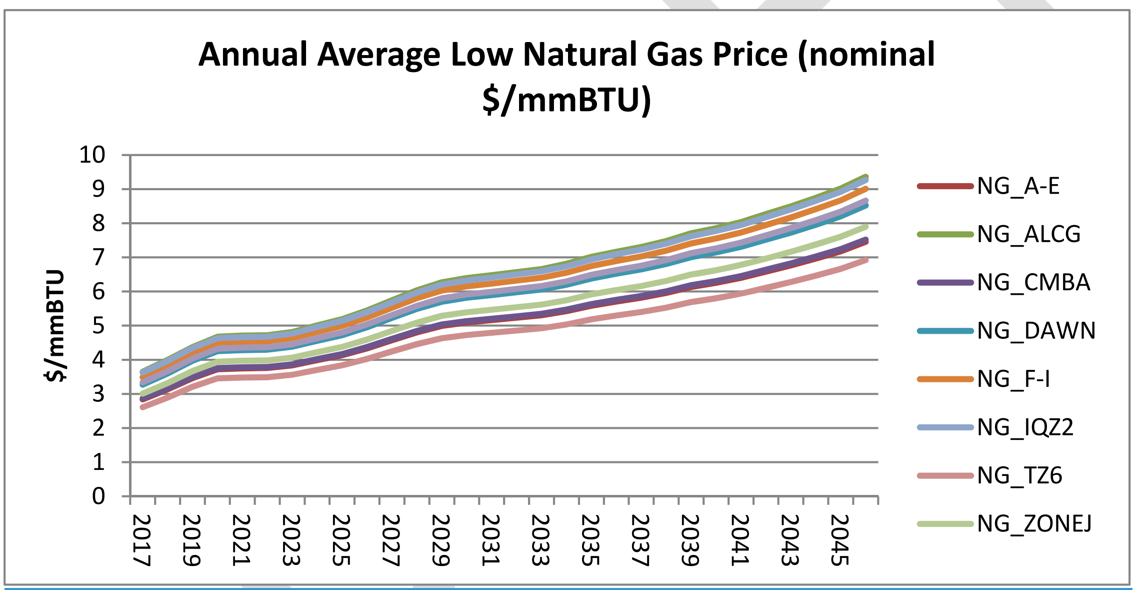


Figure 3-16: Low Natural Gas Forecast





3.2.3.2.3. Scenario #4: Clean Energy Standard (CES) with Aging Generation Retirements and National CO_2 removed

Scenario #4 assumes the integration of sufficient renewable generation and energy efficiency to meet the objectives of the Clean Energy Standard[26] along with the retirement of all New York coal

[26] New York State Department of Public Service, Staff White Paper on Clean Energy Standard, PSC Case No. 15-E-0302 (January 25, 2016).

units and approximately 3,500 MW of old GTs in NYC and Long Island~~.~~ (CES + Retirement). The NYISO also developed Scenario #4 assuming ~~the~~that a national CO_2 program is not in place. The renewable resource ~~changes~~additions are captured in Table 3-4~~. In addition, approximately~~. Approximately 17 TWh of energy efficiency was modeled. With these assumptions, approximately 50% of New York's energy requirements were projected to be served by renewable resources.

Table 3-4: Capacity of Zonal Renewable Generation added in Scenario #4 (MW)

Zone	Capacity (MW)	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Total	Land-Based Wind	-	-	73	473	317	522	346	293	285	615	657	91	780	106	4,558
	Utility-Scale Solar	-	-	-	-	462	570	-	-	1,821	1,227	338	2,930	1,241	2,893	11,482
	Offshore Wind	-	-	-	-	-	-	-	-	-	-	-	-	-	226	226
	Imports	-	-	-	-	-	258	258	-	-	-	-	-	-	-	516
Zone A	Land-Based Wind			73	367	109	47	252	86		190	79		30		1,233
	Utility-Scale Solar										108	153	732	871		1,864
	Offshore Wind															-
Zone B	Land-Based Wind															-
	Utility-Scale Solar														344	344
	Offshore Wind															-
Zone C	Land-Based Wind										59			210		269
	Utility-Scale Solar											185	1,219		2,429	3,833
	Offshore Wind															-
Zone D	Land-Based Wind															-
	Utility-Scale Solar													152		152
	Offshore Wind															-
Zone E	Land-Based Wind						162		112	245	284	553	91	429	106	1,982
	Utility-Scale Solar															-
	Offshore Wind															-
Zone F	Land-Based Wind				56	71	221	94	95	40	42	25		54		698
	Utility-Scale Solar					462	345			1,821	58		895			3,581
	Offshore Wind															-
Zone G	Land-Based Wind				50	40	92				40			57		279
	Utility-Scale Solar						143				565			218	120	1,046
	Offshore Wind															-
Zone H	Land-Based Wind															-
	Utility-Scale Solar						12									12
	Offshore Wind															-
Zone I	Land-Based Wind															-
	Utility-Scale Solar															-
	Offshore Wind															-
Zone J	Land-Based Wind															-
	Utility-Scale Solar															-
	Offshore Wind															-
Zone K	Land-Based Wind					97										97
	Utility-Scale Solar						70				496		84			650
	Offshore Wind														226	226
Imports	LBW Quebec															
	Ontario Utility Scale Solar															
	LBW Ontario						258	258								516
	LBW PJM															-
	PJM Utility Scale Solar															
Total		0	0	73	473	779	1,350	604	293	2,106	1,842	995	3,021	2,021	3,225	16,782

3.3 Evaluation Metrics

~~Consistent with the PSC's direction that no Public Policy Transmission Project shall be selected for Segment A unless a Public Policy Transmission Project is selected for Segment B, the NYISO combined each Segment A proposal with each developer's Segment B counterpart proposal.~~ ~~In order to evaluate a feasible number of possible combinations between Segment A and Segment B proposals, the NYISO developed representative combinations as follows:~~

- ~~Combining all Segment A and Segment B projects from the same developers, and~~
- ~~Combining Segment A and Segment B projects from different developers based on combinations with similar electrical characteristics.~~
  - ~~Similar Segment A projects: T018, T021, T026, T028, T031~~
  - ~~Segment A: T025~~
  - ~~Segment A: T027~~
  - ~~Similar Segment B projects: T022, T023, T029, T030, T032~~
  - ~~Segment B: T019~~

~~shows the complete list of the representative combinations that were studied by NYISO and shows how the combinations results represents other project combinations that were not studied.~~

3.3.1 PSC Evaluation Criteria

For the purposes of evaluation and selection of the more efficient or cost-effective Public Policy Transmission Project(s) to address the AC Transmission Needs, the following criteria identified by the NYPSC Order will be applied in addition to the criteria and metrics defined by Section 31.4.8 of Attachment Y to the NYISO OATT:

Table 3-5~~: Representative Combinations~~: PSC Evaluation Criteria

~~Combination ID~~	~~Representative Combination~~
~~1~~	~~T018+T019~~
~~2~~	~~T021+T022~~
~~3~~	~~T021+T023~~
~~4~~	~~T025+T019~~
~~5~~	~~T025+T029~~
~~6~~	~~T025+T030~~
~~7~~	~~T026+T029~~
~~8~~	~~T026+T030~~
~~9~~	~~T027+T019~~
~~10~~	~~T027+T029~~
~~11~~	~~T027+T030~~
~~12~~	~~T028+T029~~
~~13~~	~~T028+T030~~
~~14~~	~~T031+T032~~

~~**Table -: Project combinations Representative results**~~

~~Representative Results for Central East Voltage Transfer and Production Cost Analysis~~

PSC Criteria	Evaluation

In lieu of establishing an intended in-service year against which project schedules would be evaluated, the NYISO will consider the proposed project schedule for each Public Policy Transmission Project in the evaluation of impacts to congestion and other applicable criteria over the study period. The NYISO will assume that project schedules begin January 1 of a given year following the NYISO's selection and NYPSC Article VII siting approval (*i.e.*, project schedules need not account for the timing of the NYISO or NYPSC processes).	Considered in the Schedule metric
The selection process will favor Public Policy Transmission Projects that minimize the acquisition of property rights for new substations and substation expansions. For the purpose of this criterion, the transfer or lease of existing property rights from a current utility company owner to a Developer shall not be considered such an acquisition.	Considered in the Property Rights metric
No Public Policy Transmission Project shall be selected for Segment B that does not incorporate certain specified add-ons that would be constructed (*i.e.*, as specified in the NYPSC Order the upgrades to the Rock Tavern Substation and the upgrades to the Shoemaker to Sugarloaf transmission lines), unless the NYISO determines that such add-ons, jointly or severally, are not material to the accomplishment of the purpose of a solution for Segment B.	Considered in the selection process
The selection process for transmission solutions for Segment B shall not use the costs of upgrades to the Rock Tavern Substation and upgrades to the Shoemaker to Sugarloaf transmission lines as a distinguishing factor between Public Policy Transmission Projects.	Reflected in the capital cost estimates of all projects at the same amount
No Public Policy Transmission Project shall be selected for Segment A unless a Public Policy Transmission Project is selected for Segment B.	Combinations of Segment A and B projects considered in the selection process
No Public Policy Transmission Project shall be selected for Segment A except on condition that the Public Policy Transmission Project selected for Segment A shall not be implemented until there is reasonable certainty established in a manner to be determined by the NYISO that the Public Policy Transmission Project selected for Segment B will be implemented.	Combinations of Segment A and B projects considered in the selection process
The selection process shall favor Public Policy Transmission Projects that result in upgrades to aging infrastructure.	Evaluated as a separate metric
Project selection will be competitive by Segment (Segment A and Segment B), but synergies produced by selecting a single Developer to provide both segments may be considered.	Considered in the selection process as synergy savings from common developers of Segment A and B projects
The selection process shall not use the percentage rates applied to account for contingencies and revenue requirement as a distinguishing factor between Public Policy Transmission Projects. The NYISO will evaluate costs based on raw construction costs to ensure that all of the proposed Public Policy Transmission Projects are evaluated on a comparable basis as to the scope of costs.	Reflected in the capital cost estimates based on independently estimated raw construction costs

3.3.2	~~T018~~	~~T021~~	~~T025~~	~~T026~~	~~T027~~	~~T028~~	~~T031~~
~~T019~~	~~1~~	~~3~~	~~4~~	~~7~~	~~9~~	~~12~~	~~14~~
~~T022~~	~~1~~	~~2~~	~~5~~	~~7~~	~~10~~	~~12~~	~~14~~
~~T023~~	~~1~~	~~3~~	~~5~~	~~7~~	~~10~~	~~12~~	~~14~~
~~T029~~	~~1~~	~~3~~	~~5~~	~~7~~	~~10~~	~~12~~	~~14~~
~~T030~~	~~1~~	~~3~~	~~6~~	~~8~~	~~11~~	~~13~~	~~14~~
~~T032~~	~~1~~	~~3~~	~~5~~	~~7~~	~~10~~	~~12~~	~~14~~

~~Representative Results for UPNY-SENY Thermal Transfer~~

	~~T018~~	~~T021~~	~~T025~~	~~T026~~	~~T027~~	~~T028~~	~~T031~~
~~T019~~	~~1~~	~~1~~	~~4~~	~~1~~	~~9~~	~~1~~	~~1~~
~~T022~~	~~2~~	~~2~~	~~5~~	~~2~~	~~10~~	~~2~~	~~2~~
~~T023~~	~~3~~	~~3~~	~~5~~	~~3~~	~~10~~	~~3~~	~~3~~
~~T029~~	~~7~~	~~7~~	~~5~~	~~7~~	~~10~~	~~12~~	~~12~~
~~T030~~	~~8~~	~~8~~	~~6~~	~~8~~	~~11~~	~~13~~	~~13~~
~~T032~~	~~14~~	~~14~~	~~5~~	~~14~~	~~10~~	~~14~~	~~14~~

~~3.3.1~~ Capital Cost Estimate

The NYISO and its independent consultant, SECO, evaluated each Developer's capital cost estimates for their proposed Public Policy Transmission Project for accuracy and reasonableness, and on a comparative basis with other proposed Public Policy Transmission Projects. Each Developer was required to submit detailed and credible estimates for the capital costs associated with the engineering, procurement, permitting, and construction of a proposed transmission solution. SECO reviewed all the information submitted by the Developers and ~~developed~~formulated independent cost estimates for each project based on material and labor cost by equipment, engineering and design work, permitting, site acquisition, procurement and construction work, and commissioning needed for the proposed Public Policy Transmission Projects. Appendix D details the analysis performed by SECO. Consistent with the PSC's direction that the costs should be evaluated using raw construction costs on a comparable basis, the NYISO applied the same contingency rate to the independent consultant's capital cost estimates for all projects. Also, per the PSC's criterion that the selection process for transmission solutions for Segment B not use the costs of upgrades to the Rock Tavern Substation and upgrades to the Shoemaker to Sugarloaf transmission lines as a distinguishing factor between Public Policy Transmission Projects, the NYISO and its independent consultant SECO excluded these costs from the cost estimates.

Table 3-6 summarizes SECO's overnight capital cost estimates for Segment A and Segment B projects in 2018 dollars~~:~~ with and without 30% contingency rate. The 30% contingency rate was used in the New York State Department of Public Service Trial Staff Final Report.[27] SECO reviewed it and agreed that the level of contingency is sufficient to account for unanticipated costs and estimating accuracy to forecast a reasonable worst case scenario for the development of the selected project(s).

[27] *See Comparative Evaluation of Alternating Current Transmission Upgrade Alternatives*, New York State Department of Public Service Trial Staff Final Report, PSC Case Nos. 12-T-0502, *et al.* (September 22, 2015).

Table 3-6: Independent Cost Estimate[28]

Segment	Project ID	Independent Cost Estimate: 2018 $M (w/ 30% contingency rate)	Independent Cost Estimate: 2018 $M (w/o 30% contingency rate)
A	T018	520	400
	T021	498	383
	T025	~~861~~863	~~662~~664
	T026	~~489~~491	~~376~~377
	T027	~~741~~750	~~570~~577
	T028	~~512~~514	~~394~~395
	T031	570	438
B	T019	445	342
	T022	~~357~~338	~~274~~260
	T023	390	300
	T029	387	298
	T030	406	313
	T032	502	386

projects. The five percent synergy savings level is based on SECO's experience in developing transmission projects, and is calculated by evaluating the average cost of individual cost components of the projects and represents a conservative estimate of the cost savings a Developer could realize if awarded projects for both Segments. These individual cost components included items such as Labor & Equipment, Matting, Materials, Contractor Mobilization/Demobilization, Project Management, Field Construction Management and Inspection Staffing, Incumbent Utility Project Manager and Project Oversite, Site Facilities, Material Handling & Storage, Design Engineering, LiDAR, Geotech, Testing & Commissioning of T-Line and Equipment, Contractor Warranties, Legal Fees, and Contractor Markup (Overhead & Profit). Each of these items were assessed for economy of scale; utilization of resources, equipment and materials; duplication of services; and replication of engineering designs to estimate the potential savings.

Table 3-7 summarizes the cost estimates for all the Segment A and Segment B project combinations. The NYISO considered a ~~5%~~five percent synergy in cost estimates if the same ~~developer~~Developer were to develop both Segment A and Segment B projects. PSC's criteria allows

[28] At the time that this draft report was released, the System Impact Studies for all of the projects were still in progress. Hence, the NYISO provided two sets of cost estimates—one cost estimate with the cost of potential Network Upgrade Facilities (NUF), equaling 30%, applied to all projects to account for any system upgrades that may be identified through the NYISO's Transmission Interconnection Procedures, and the other cost estimate without including any costs for potential NUF.

for consideration of cost synergies if the same developer ~~were to develop~~develops both Segment A and Segment B projects. The five percent synergy savings level is based on SECO's experience in developing transmission projects, and is calculated by evaluating the average cost of individual cost components of the projects and represents a conservative estimate of the cost savings a Developer could realize if awarded projects for both Segments. These individual cost components included items such as Labor & Equipment, Matting, Materials, Contractor Mobilization/Demobilization, Project Management, Field Construction Management and Inspection Staffing, Incumbent Utility Project Manager and Project Oversite, Site Facilities, Material Handling & Storage, Design Engineering, LiDAR, Geotech, Testing & Commissioning of T-Line and Equipment, Contractor Warranties, Legal Fees, and Contractor Markup (Overhead & Profit). Each of these items were assessed for economy of scale; utilization of resources, equipment and materials; duplication of services; and replication of engineering designs to estimate the potential savings.

Table 3-7: Independent Cost Estimate – Project Combinations

Developers	Project ID	Independent Cost Estimate: 2018 $M (w/ 30% contingency rate) (w/o synergies)	Independent Cost Estimate: 2018 $M (w/ 30% contingency rate) (w/ 5% synergies if same developers)
Same Developers	T018+T019		917
	T021+T022		~~812~~794
	T021+T023		843
	T025+T029		~~1159~~1161
	T025+T030		~~1177~~1179
	T026+T029		~~832~~834
	T026+T030		~~850~~852
	T027+T029		~~1072~~1080
	T027+T030		1098~~1090~~
	T028+T029		~~854~~856
	T028+T030		~~873~~874
	T031+T032		1018
Different Developers	T021+T019	943	
	T025+T019	~~1273~~1275	
	T026+T019	~~934~~936	
	T027+T019	~~1186~~1195	
	T028+T019	~~957~~959	
	T031+T019	1015	
	T018+T022	~~877~~858	
	T025+T022	~~1189~~1173	
	T026+T022	~~846~~829	
	T027+T022	1088~~1098~~	
	T028+T022	~~869~~852	
	T031+T022	~~927~~908	

	T018+T023	910	
	T025+T023	~~1222~~1224	
	T026+T023	~~878~~880	
	T027+T023	~~1131~~1139	
	T028+T023	~~902~~904	
	T031+T023	960	
	T018+T029	~~907~~908	
	T021+T029	885	
	T031+T029	957	
	T018+T030	926	
	T021+T030	904	
	T031+T030	976	
	T018+T032	1022	
	T021+T032	1000	
	T025+T032	~~1323~~1325	
	T026+T032	~~991~~993	
	T027+T032	~~1243~~1252	
	T028+T032	~~1014~~1016	

3.3.~~2~~3 Cost Per MW Ratio

The cost per MW ratio metric was calculated by dividing SECO's independent cost estimates by the MW value of transfer capability. For the purpose of calculating cost per MW based on transfer limits, the NYISO calculated the Central East voltage transfer limits and UPNY~~-~~/SENY thermal transfer limits. . The incremental increase for Central East is defined in terms of increases in voltage transfer capability because that interface is limited by voltage transfer limits. For UPNY/SENY, the incremental increase is defined in terms of increases in thermal transfer capability because that interface in limited by thermal transfer limits.

Table 3-8 and Table 3-9 ~~and summarize the baseline transfer results.~~

summarize the baseline transfer results. The incremental increase for Central East is defined in terms of increases in voltage transfer capability because that interface is limited by voltage transfer limits. For UPNY/SENY, the incremental increase is defined in terms of increases in thermal transfer capability because that interface in limited by thermal transfer limits.

Table 3-8: Voltage Transfer across Central East

Project ID	Transfer Limit	Incremental
Pre-Project	2,575	~~-~~-
T018+T019	3,000	425
T021+T022	2,925	350
T021+T023	2,925	350

T025+T019	3,875	1,300
T025+T029	3,700	1,125
T025+T030	3,775	1,200
T026+T029	2,850	275
T026+T030	2,850	275
T027+T019	3,450	875
T027+T029	3,400	825
T027+T030	3,400	825
T028+T029	2,975	400
T028+T030	2,900	325
T031+T032	2,975	400

Table 3-9: Thermal Transfer across UPNY-~~-~~/SENY

Project ID	Roseton at 100%			Roseton at 85%			Optimal Transfer Limit		
	Limit	Constraint	Delta	Limit	Constraint	Delta	Limit	Constraint	Delta
Pre-Project	4775	(1)	-	4825	(1)	-	5025	(1)	-
T018+T019	6375	(2)(A)	1600	6500	(2)(A)	1675	7000	(2)	1975
T021+T022	5975	(3)	1200	6350	(1)	1525	6525	(1)	1500
T021+T023	5975	(3)	1200	6300	(1)	1475	6475	(1)	1450
T025+T019	5825	(4)	1050	5825	(4)	1000	6175	(4)	1150
T025+T029	6600	(3)	1825	6950	(1)	2125	7250	(1)	2225
T025+T030	6700	(3)	1925	7100	(1)	2275	7350	(1)	2325
T026+T029	5925	(3)	1150	6225	(1)	1400	6425	(1)	1400
T026+T030	6000	(3)	1225	6375	(1)	1550	6550	(1)	1525
T027+T019	6525	(2)(A)	1750	6700	(2)(A)	1875	7125	(2)	2100
T027+T029	6125	(3)	1350	6150	(1)	1325	6350	(1)	1325
T027+T030	6175	(3)	1400	6300	(1)	1475	6475	(1)	1450
T028+T029	5950	(3)	1175	6250	(1)	1425	6450	(1)	1425
T028+T030	6025	(3)	1250	6400	(1)	1575	6575	(1)	1550
T031+T032	6000	(3)	1225	6325	(1)	1500	6500	(1)	1475

~~(1) Leeds - Pleasant Valley at 1538 MW LTE rating for TE44:L/O ATHENS-PV 345 91~~
~~(2) Middletown Transformer at 707 MW STE rating for T:77&76~~
~~(3) Roseton - East Fishkill at 2676 MW LTE rating for T:77&76~~
~~(4) Knickerbocker Series Comp at 2308 MW LTE rating for T:34&44~~

~~(A) Limited by cascading test~~

Notes:
(1) Leeds - Pleasant Valley at 1538 MW LTE rating for TE44:L/O ATHENS-PV 345 91
(2) Middletown Transformer at 707 MW STE rating for T:77&76
(3) Roseton - East Fishkill at 2676 MW LTE rating for T:77&76
(4) Knickerbocker Series Comp at 2308 MW LTE rating for T:34&44

(A) Limited by cascading test

Table 3-10 displays the cost per MW ($M/MW) ratio based on transfer limits. The table displays the proportional UPNY~~-~~/SENY transfer limit with Roseton dispatched at 100% and 85% as well as the optimal UPNY~~-~~/SENY transfer limit.

Table 3-10: Cost Per MW Ratio

Project ID	Segment A Independent Cost Estimate: 2018 $M	Segment B Independent Cost Estimate: 2018 $M	Cost/MW: incremental Central East Voltage Limit (N-1)		Cost/MW: incremental UPNY~~-~~/SENY thermal Limit (N-1 NTC)					
					Roseton at 100%		Roseton at 85%		Optimized Transfer	
			Inc. MW	$M /MW	Inc. MW	$M /MW	Inc. MW	$M /MW	Inc. MW	$M /MW
T018+T019	494	423	425	1.16	1,600	0.26	1,675	0.25	~~1,998~~ 1975	0.21
T021+T022	473	~~339~~ 321	350	1.35	1,200	0.~~28~~27	1,525	0.~~22~~21	~~1,519~~ 1500	0.~~22~~21
T021+T023	473	370	350	1.35	1,200	0.31	1,475	0.25	~~1,466~~ 1450	0.25
T025+T019	~~861~~ 863	445	1,300	0.66	1,050	0.42	1,000	0.45	~~1,163~~ 1150	0.38
T025+T029	~~818~~ 820	368	1,125	0.73	1,825	0.20	2,125	0.17	~~2,226~~ 2225	0.17
T025+T030	~~818~~ 820	386	1,200	0.68	1,925	0.20	2,275	0.17	~~2,342~~ 2325	0.16
T026+T029	~~464~~ 466	368	275	1.69	1,150	0.32	1,400	0.26	~~1,401~~ 1400	0.26
T026+T030	~~464~~ 466	386	275	1.69	1,200	0.32	1,525	0.25	~~1,535~~ 1525	0.25
T027+T019	~~741~~ 750	445	875	0.~~85~~86	1,750	0.25	1,875	0.24	~~2,103~~ 2100	0.21
T027+T029	~~704~~ 712	368	825	0.~~85~~86	1,350	0.27	1,325	0.28	~~1,326~~ 1325	0.28
T027+T030	~~704~~ 712	386	825	0.~~85~~86	1,400	0.28	1,475	0.26	~~1,470~~ 1450	0.26
T028+T029	~~487~~ 488	368	400	1.22	1,175	0.31	1,425	0.26	~~1,427~~ 1425	0.26
T028+T030	~~487~~ 488	386	325	1.50	1,250	0.31	1,575	0.25	~~1,569~~ 1550	0.25
T031+T032	542	477	400	1.35	1,225	0.39	1,500	0.32	~~1,476~~ 1475	0.32

3.3.~~3~~4 Expandability

In assessing the expandability of the proposed projects, the NYISO considers the feasibility and ease of physically expanding a facility, which can include consideration of future opportunities to economically expand a facility and the likelihood of future transmission siting. Such consideration may include future modifications to increase equipment ratings of the proposed facilities, staging or phasing of future transmission development, or otherwise benefiting from the proposed facilities for future reliability or congestion relief purposes. The details are summarized in the following sections.

3.3.~~3~~4.1 Physical Expandability

The NYISO contracted ~~the~~SECO as its independent consultant~~, SECO,~~ to perform the project expandability assessment to account for any possibilities of facilitating future transmission or substation expansion or generation interconnection as the result of the project proposals. SECO conducted evaluation of the expansion capability of the Developers' proposals by using the projects' information submitted by the Developers during the Viability and Sufficiency Assessment and additional information, specifically on expandability, provided by Developers in response to a request for additional information by the NYISO.

Applicable design approaches to enhance future expandability are limited in the AC Public Policy Transmission Projects since only the existing rights-of-way (ROW) can be utilized. Much of the existing transmission ROW will be fully utilized in construction of this project, but there remains is some opportunity for expansion.

Potential transmission expansion includes the following:

- All proposals for Segment A involve replacement of the existing Porter-Rotterdam 230 kV circuits #30 and #31 with a single Edic to New Scotland 345 kV line. This will provide space for future use of the existing ROW and may allow for the addition of another circuit from Edic/Porter to Princetown Junction within the existing ROW, based on current electrical clearance requirements. Any proposal to construct an additional circuit is subject to the applicable permitting and regulatory requirements, such as public acceptance of visual impact, EMF compliance, compatibility with existing gas facilities, and regulatory approvals.
    - For the base proposals, NextEra affords the most efficient use of the existing ROW by utilizing 100 ~~ft.~~foot single-pole delta structures. National Grid/Transco, NAT/NYPA and ITC propose using 65-85 ~~ft.~~foot H-pole structures, which requires the use of more space within the ROW. In all base proposals, there may be adequate space in the existing ROW

remaining for an additional 345 kV line. However, a compact transmission line configuration may be required to fit a future 345 kV line in the remaining ROW.

- All alternative proposals may also provide adequate space within the existing ROW for a future line~~ with the exception of NAT/NYPA.~~ T027~~. The NAT/NYPA T027 double circuit line proposal~~ utilizes all ~~4~~four existing circuit positions for the first 12 miles out of Edic.
- During detailed engineering the placement of structures should be optimized to maximize the remaining ROW.
- Refer to the Table 3-11~~table~~ below for summary of the ROW requirements for each Developer's projects in the Edic to Princetown Junction corridor.

Table 3-11: ROW requirements in the Edic to Princetown Junction corridor

Segment-A							
Sector	**Corridor Width (ft.)**	**Developer**	**Proposal**	**Proposed Structure Configuration**	**ROW Reqd. (ft.)**	**ROW Corridor Remaining (ft.)**	**Remarks**
Edic SS to Prince-town Jct	200	NGRID/ Transco	T018	1 Ckt – 345kV H-pole Horizontal	120	80	Sufficient reserved ROW for expansion utilizing Compact Vertical Configuration
		NextEra	T021	1 Ckt – 345kV Single Pole Delta	80	120	Sufficient reserved ROW for expansion utilizing H-pole Horizontal Configuration
		NYPA/NAT	T026 & T028	1 Ckt – 345kV H-pole Horizontal	140 ~~(a)~~	60 ~~(a)~~	Sufficient reserved ROW for expansion utilizing Compact Vertical Configuration
		NYPA/NAT	T027	2 Ckt – 345kV Single Pole Vertical	105	95	Sufficient reserved ROW for expansion utilizing Single Pole Delta Configuration with exception of the first 12.6 miles out of Edic
		ITC	T031	1 Ckt – 345kV H-pole Horizontal	100 ~~(b)~~	100 ~~(b)~~	Sufficient reserved ROW for expansion utilizing Single Pole Delta Configuration

~~*(a) For NYPA/NAT proposals T026 & T028, 24 spans are limiting the remaining corridor to 60 ft. If, in the final design, the ROW requirement can be kept to within 60 ft. of either side of centerline (through increased tension, shorter span lengths or special design), the ROW required would be 120 ft., leaving 80 ft. for future expansion.*~~

~~*(b) The ITC proposal T031 is able to have less of an ROW requirement due to using more structures and shorter span lengths.*~~

- The new Edic to New Scotland line for Segment A could be designed for double circuit capability similar to the NAT/NYPA T027 double circuit line proposal.
- Transmission lines could be constructed with higher ampacity conductor or re-conductored in the future.

- Most proposals provide for future expansion of substations or could be modified to provide for additional line terminals and transformers in the new substations.

Potential substation expansion for each Developer's specific proposal is discussed in ~~the~~ **Table 3-12**.

Table 3-12: AC Transmission Projects Substation Expandability Analysis

Segment	Project ID	Substation Expandability
A	T018	At Rotterdam Substation, the 345 kV gas-insulated substation design provides one open ~~345kV~~345 kV bay position and room for additional 345 kV bays. Design also provides ability to connect one additional 345 kV/115 kV transformer to support the local transmission system. Lastly, the design allows for the rebuilding of the 115 kV straight bus configuration into a breaker-and-a-half configuration.
	T021	NextEra is proposing a "Princetown" substation approximately ~~2~~two miles west of Rotterdam Substation on a new greenfield site. The design provides two open 345 kV bay positions and room on the property for adding bays. It maintains the existing and aging Rotterdam 230 kV yard intact.
	T025, T027, T028	At Rotterdam, rebuilding and relocating the 345 kV substation allows for the rebuilding of the 115 kV straight bus configuration into a breaker-and-a-half configuration. A new Princetown Substation is proposed at the junction of the 345 kV Edic-New Scotland line and the 230 kV Porter to Rotterdam lines. Due to the proximity to the neighboring properties, constructing or expanding the substation will be difficult. T025 also creates an open line terminal position at New Scotland substation.
	T026	At Rotterdam, rebuilding and relocating the 345 kV substation allows for the rebuilding of the 115 kV straight bus configuration into a breaker-and-a-half configuration. The proposed design for New Scotland provides the possibility of reconfiguring the substation as a breaker-and-a-half.
	T031	ITC's proposal does not provide any additional bays at Princetown or Rotterdam Substations. ITC's proposal maintains the existing and aging Rotterdam 230 kV yard intact. Additionally, physical limitations at these properties may preclude future expansions without purchasing additional property.
B	T019	At Knickerbocker Substation, the design provides one open 345 kV bay position. The Knickerbocker design also allows the 345 kV ring bus configuration to be converted to a breaker-and-a-half configuration with room on the property for adding bays. At Churchtown Substation, design provides one open 115 kV bay position. Additional breaker-and-a-half bays can be added in the future.
	T022, T023	At Knickerbocker Substation, the proposed design provides one open 345 kV bay position. The Knickerbocker design also allows the 345 kV ring bus configuration to be converted to a breaker-and-a-half configuration with room on the property for adding bays. At North Churchtown Substation, design provides one open 115 kV bay position ~~and~~ with room on the property for adding bays. The southern-most bay could also be built out to a breaker-and-a-half configuration.
	T029, T030	The Developer proposes a new 115 kV breaker-and-a-half substation and eliminates the existing NYSEG Churchtown substation. The three-bay substation is proposed for south of the existing substation and north of Orchard Road. This location will permit future expansion of the proposed substation to the north. At Knickerbocker, the Developer's design allows the 345 kV ring bus configuration to be converted to a breaker-and-a-half configuration with room on the property for adding bays.
	T032	At Knickerbocker Substation, design provides one open 345 kV bay position and one open 115 kV bay position. Additionally, during detailed design, the ability to connect up to two 345 kV – 115 kV transformers to support the local transmission system could be provided.

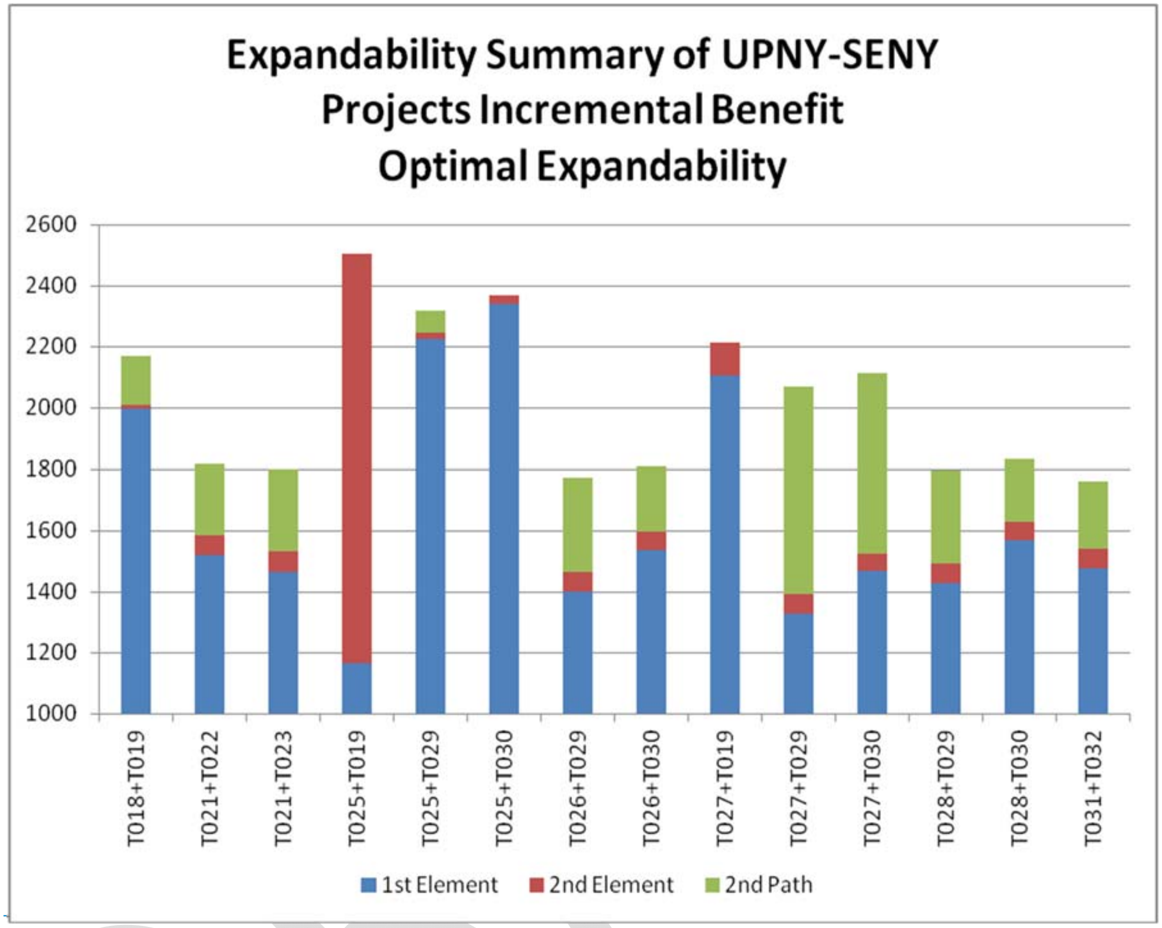
3.3.~~3~~4.2 Electrical Expandability

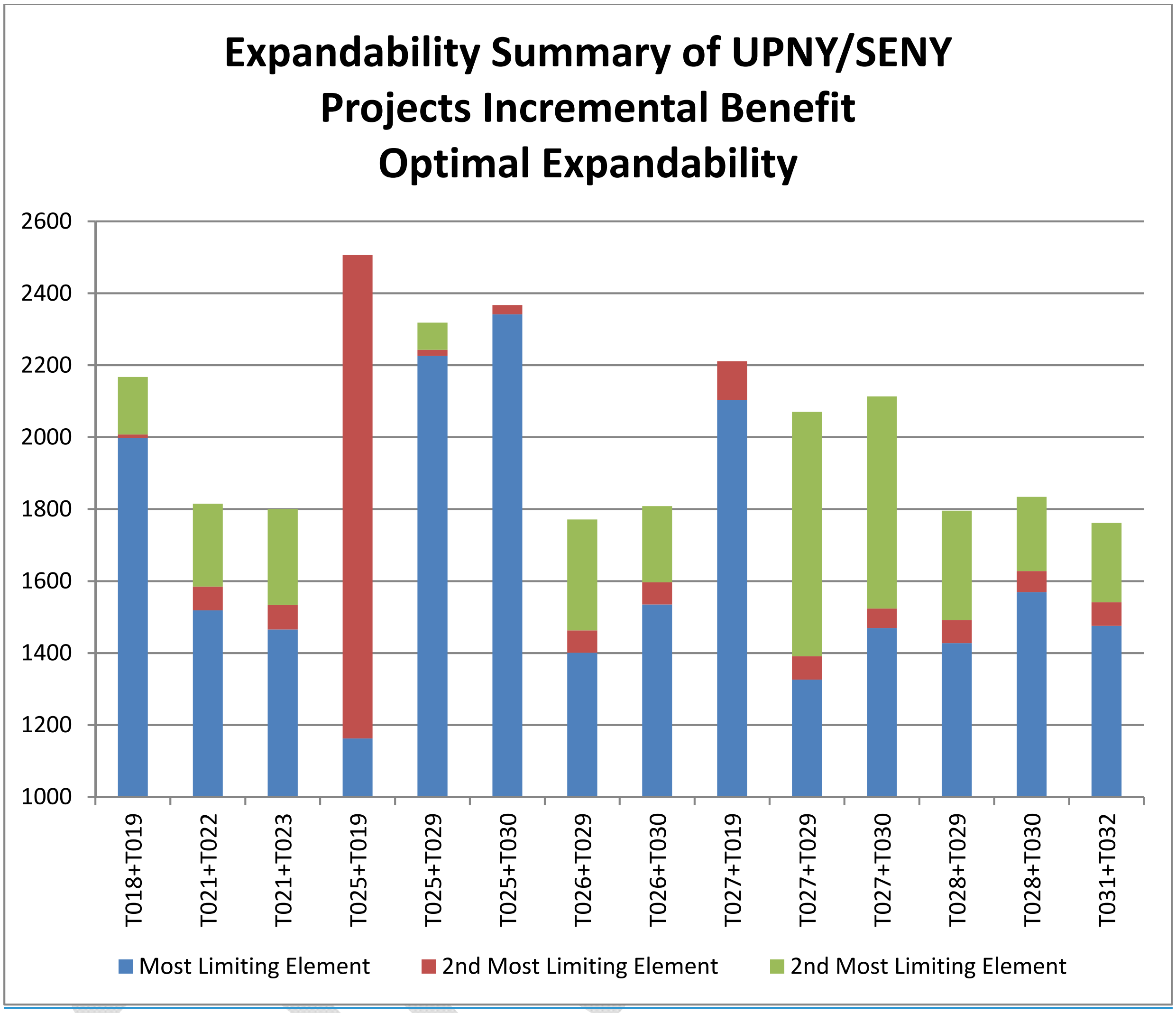
This analysis focused on the potential incremental transfer limits of each proposed project if the limiting element or path is resolved by future additional transmission expansion.

The optimal N-1 UPNY~~-~~/SENY transfer limits and the constraints summarized in Section 3.~~3.~~2.1.2 were analyzed to determine the most limiting element. To find the next most limiting element, the optimal N-1 transfer level was calculated again while excluding the most limiting monitored element. To find the next most limiting path, this process was repeated until a new limiting pathway was found. The incremental transfer capability between the transfer limits constrained by the most limiting element and the second most limiting element captures the electrical benefits of future modifications to increase equipment ratings of the most limiting facilities. Furthermore, if expansion can be made to the entire constraint path, the electrical benefits could be approximated by the incremental transfer capability. Based on the results of the transfer limit analysis, the NYISO determined the two transfer paths are: (i) the Marcy South path~~(MS)~~ and (ii) the Leeds-Pleasant Valley corridor~~ (LPV)~~.

Figure 3-17 summarizes the potential benefits using Optimal N-1 Transfers. The blue portion of the bars represents the transfer limits based on the project proposal, the red portion represents the transfer limits ~~should~~if the most limiting constraint ~~being~~shown in Table 3-9 is resolved, and the green portion represents the transfer limits should the most limiting transfer path be resolved. The limiting path for combinations T018 + T019 and T027 + T019 would be the Marcy South path, while the other combinations would be the Leeds-Pleasant Valley corridor.

Figure 3-17: Electrical Expandability Analysis





3.3.4.3 Summary of Expandability Assessment

The NYISO used the assessment of incremental transfer limits as a proxy to determine the network strength and potential benefits if these project proposals could be expanded based on their substation designs. The project proposals that have substation designs with potentials to accommodate transmission expansion to significantly increase transfer limits are considered more favorable and are ranked as "Good". However, if the transfer limits could be increased or such increase could be handled more efficiently compared to other projects, those projects are ranked as "Excellent".

Table 3-13~~: Electrical~~: Expandability ~~Limiting Path~~Summary

Segment	Project ID	~~T018+T019~~Project Components with the Potential for Expansion	~~T021+~~Ranking~~T022~~	~~T021+T023~~	~~T025+T019~~	~~T025+T029~~	~~T025+T030~~	~~T026+T029~~	~~T026+T030~~	~~T027+T019~~	~~T027+T029~~	~~T027+T030~~	~~T028+T029~~	~~T028+T030~~	~~T031+T032~~
~~Optimal Transfers~~ A	~~MS~~T018	~~LPV~~Rotterdam Substation and ability to connect one additional 345 kV -115 kV transformer at Rotterdam	~~LPV~~Good	~~LPV~~	~~LPV~~	~~LPV~~	~~LPV~~	~~LPV~~	~~MS~~	~~LPV~~	~~LPV~~	~~LPV~~	~~LPV~~	~~LPV~~	
	T021	Princetown	Good												
	T025	Rotterdam, New Scotland	Good												
	T027	Rotterdam, New Scotland. Additionally, Double-circuit design tends to maximize the Central East transfer capability	Excellent												
	T028	Rotterdam, New Scotland	Good												
	T026	Rotterdam	Good												
	T031	-	Good												
B	T019	Knickerbocker, Churchtown	Good												
	T022	Knickerbocker, Churchtown	Good												
	T023	-	Good												
	T029	Knickerbocker, Churchtown	Good												
	T030	Knickerbocker, Churchtown	Good												
	T032	Knickerbocker station and ability to connect two	Good												

		345kV -115 kV transformers	

3.3.~~4~~5 Operability

The NYISO considered how the proposed Public Policy Transmission Projects affect flexibility in operating the system, such as dispatch of generation, access to operating reserves, access to ancillary services, or the ability to remove transmission facilities for maintenance. The NYISO also considered how the proposed projects may affect the cost of operating the system, such as how they may affect the need for operating generation out of merit for reliability needs, reduce the need to cycle generation, or provide more balance in the system to respond to system conditions that are more severe than design conditions.

3.3.~~4~~5.1 Substation Configuration Assessment

The operability of the proposals was evaluated by the NYISO and also by ~~the independent consultant,~~ SECO. The following factors were considered in evaluating each of the proposals:

1. Level of ~~Integration: Operational~~integration: operational preference is for a project that would integrate with the existing New York State Transmission System to the maximum extent possible. For example, a project using an existing right-of-way (ROW) should not bypass existing substations on the ROW except for reasons such as short circuit limitations, space limitations, and design perspective where a new substation is desirable.

2. Substation ~~Design Configuration: Operational~~design configuration: operational preference is for substation designs in the following order: double-breaker-double-bus, a breaker-and-a-half, ring bus, main and transfer bus, sectionalized bus, and straight (single) bus.

3. Transfer ~~Capability Impact with Project Component Out of Service: From~~capability under outage conditions: from an operations perspective, it is desirable for a project not to lose its improvement to transfer capability as a result of the loss of any ~~of the project's~~transmission component.

In this assessment, the proposed projects have the greatest impact on the following three substations: Princetown 345 kV, Rotterdam 345 kV, and Knickerbocker 345 kV Substations. Based on the substation configuration, the findings and comparisons are summarized in Table 3-14 for Princetown 345 kV Substation, and Table 3-15 for Rotterdam 345 kV Substation, and **Table 3-16** for Knickerbocker 345 kV Substation.

Table 3-14: Princetown 345 kV Substation Arrangement Comparison

Developer	# of new Lines	# of new Transformers	Total new elements	Proposed Breaker Arrangement	# of Breakers
T018 NGRID/Transco	No Princetown Substation proposed.				
T021 NextEra	2 – 345kV 2 – 230kV	2	6	Breaker & Half	7 – 345kV 6 – 230kV
T026 NYPA/NAT	No Princetown Substation proposed.				
T025 NYPA/NAT	4	0	4	Ring Bus	4
T027 NYPA/NAT	6	0	6	Breaker & Half	9
T028 NYPA/NAT	4	0	4	Ring Bus	4
T031 ITC	8	0	8	Breaker & Half	12

~~Proposals~~ T021 and T031~~, proposes~~ offer a breaker-and-a-half configuration for Princetown Substation. ~~Proposal~~ T021 has three bays, and ~~proposal~~ T031 has four bays. Potential issues with siting the Princetown substation ~~were~~are discussed in the Risk Analysis section ~~above.~~of the report. Proposals T025 and T028, proposes a four-breaker ring-bus configuration for Princetown Substation. For ~~proposal~~ T027, NYPA/NAT proposes a gas-insulated three-bay breaker-and-a-half configuration.

Table 3-15: Rotterdam 345 kV Substation Arrangement Comparison

Developer	# of new Lines	# of new Transformers	Total new elements	Proposed Breaker Arrangement	# of Breakers
T018 NGRID/Transco	2 – 345kV 1 – 230kV 2 – 115kV*	1 – 345kV-230kV 2 – 345kV-115kV	8	Breaker & Half (Gas-Insulated)	9 – 345kV 1 – 230kV
T021 NextEra	No changes to Rotterdam proposed.				
T026 NYPA/NAT	2 – 345kV 1 – 230kV 2 – 115kV*	1 – 345kV-230kV 2 – 345kV-115kV	8	Breaker & Half	8 – 345kV 1 – 230kV
T025 NYPA/NAT	Same as T026				
T027 NYPA/NAT	Same as T026				
T028 NYPA/NAT	Same as T026				
T031 ITC	2 – 345kV	2 – 345kV-230kV	4	Sectionalized Bus	3 – 345kV 1 – 230kV
*These are tie lines to the existing 115 kV yard at Rotterdam.					

Proposals T018, T025, T026, T027 and T028 propose new 345 kV breaker-and-a-half substations at Rotterdam. These proposals also add two 345 kV-115 kV transformers and one 345 kV-230 kV transformer. ~~Proposal~~ T031 adds a 345 kV sectionalized bus yard to the north side of the existing Rotterdam 230 kV yard. ~~Proposal~~ T021 makes no changes to the existing Rotterdam bus arrangement.

Table 3-16: Knickerbocker 345 kV Substation Arrangement Comparison

Developer	# of new Lines	# of new Transformers	Total new elements	Proposed Breaker Arrangement	# of Breakers
T019 NGRID/Transco	3	0	3 (also includes Series Compensation)	Ring Bus (built for future Breaker & Half)	3
T022 NextEra	3	0	3	Ring Bus (built for future Breaker & Half)	3
T023 NextEra	Same as T022.				
T025 NYPA/NAT	1 – 765kV 2 – 345kV	2	5	765kV – Ring Bus 345kV – Ring Bus	3 – 765kV 4 – 345kV
T029 NYPA/NAT	3	0	3	Ring Bus (built for future Breaker & Half)	3
T030 NYPA/NAT	Same as T029.				
T032 ITC	3 – 345kV 3 – 115kV	0	6	345kV - Ring Bus 115kV – Ring Bus	3 – 345kV 3 – 115kV

Except for combinations that include ~~proposal~~ T025, all Developers propose a new Knickerbocker Substation with similar 345 kV ring bus arrangements. ~~Proposal~~ T019 includes Series Compensation on the line terminal to Pleasant Valley. ~~Proposal~~ T032 adds an independent 115 kV ring bus yard. ~~Proposal~~ T025 proposes a 765 kV ring bus yard and a 345 kV ring bus yard with two 765 kV – 345 kV transformers. ~~Proposal~~ T025 will also require the installation of a new 765 kV breaker and associated equipment at the Marcy Substation.

3.3.~~4~~5.2 ~~Dispatch Flexibility~~

~~The network configuration, load levels, and generation available for dispatch vary from day to day and sometimes from second to second. While the transfer limit analysis was conducted for the peak load condition assuming all generation shifted was sunk entirely in the New York Control Area, the analysis in this section identified another set of transfer limits that shows the effect of sinking to different areas including New England. The transfer limit analysis was performed using several sinks as sensitivities, and the resulting transfer limits are summarized in the table below.~~

~~Table -: Impact to Grid Operations~~

~~Project ID~~	~~Sink~~	~~Monitored Element~~			~~Limit~~	~~Delta~~
~~Pre-Project~~	~~50% F / 50% G~~	~~MARCY~~	~~Base Case~~	~~Voltage Violation~~	~~2,575~~	

~~T025+T029~~	~~50% F / 50% G~~	~~EDIC~~	~~Base Case~~	~~Voltage Violation~~	~~3,700~~	~~1,125~~
~~T027+T029~~	~~50% F / 50% G~~	~~EDIC~~	~~Base Case~~	~~Voltage Violation~~	~~3,400~~	~~825~~
~~Pre-Project~~	~~35% F / 65% NE~~	~~T:34&44_CE18/UC30~~		~~Collapse~~	~~2,850~~	
~~T025+T029~~	~~35% F / 65% NE~~	~~KB765~~	~~T:34&44_CE18/UC30~~	~~Voltage Violation~~	~~3,875~~	~~1,025~~
~~T027+T029~~	~~35% F / 65% NE~~	~~ROTTERDAM~~	~~T:34&44_CE18/UC30~~	~~Voltage Violation~~	~~3,750~~	~~900~~

~~3.3.4.3~~ Benefits under Maintenance Conditions

These Central East voltage transfer limits were found after an N-1 outage of a major transmission line that would affect the Central East interface. These results are based on the 2016 RPP case with updates detailed in Section 3.2.1 and use the same methodology as the N-1 Central East Voltage Transfers results in

Table 3-17and **Table 3-8**.

Table 3-17: Central East N-1-1 Voltage Transfer Capability

Project ID	Maintenance Outage	Transfer Limit	Delta
Pre-Project	Marcy-New Scotland 345 kV Line	1,861	-
T021+T022	Marcy-Princetown 345 kV Line	2,250	389
T025+T019	Marcy-Knickerbocker 765 kV Line	2,165	304
T025+T029	Marcy-Knickerbocker 765 kV Line	2,243	382
T027+T019	Marcy-New Scotland 345 kV Line	2,976	1,115
T027+T029	Marcy-New Scotland 345 kV Line	2,883	1,022
T031+T032	Marcy-Princetown 345 kV Line	2,400	539
T018+T019	Marcy-New Scotland 345 kV Line	2,285	424

The following thermal transfer analysis calculates the N-1 transfer capability under different system maintenance conditions by using optimal N-1-1 transfer limits. The N-1-1 transfer analysis optimally shifts generation from Ontario and Upstate New York and sinks it to the Lower Hudson Valley while securing New York elements to both their pre- and post-contingency ratings. When an overload cannot be mitigated, the optimal transfer limit is determined. Internal NYC PARs were optimized to mitigate local overloads.

Based on the 2016 RPP case with the updates detailed in Section 3.2.1, the ~~table~~Table 3-20 below shows the N-1-1 transfer limits.

Table 3-18: Incremental UPNY~~-~~/SENY N-1-1 Thermal Transfer Capability

~~Maintenance Outage~~	~~No Outage~~		~~CPV - Rock Tavern 345 kV Line~~		~~Marcy - Coopers Corners 345 kV Line~~		~~Roseton - East Fishkill 345 kV Line~~		~~Athens-Pleasant Valley 345 kV Line~~	
~~Pre-Project~~	~~5025~~	~~(1)~~	~~4369~~	~~(1)~~	~~4505~~	~~(1)~~	~~3763~~	~~(1)~~	~~3339~~	~~(2)~~
~~T018+T019~~	~~7023~~	~~(3)~~	~~6443~~	~~(4)~~	~~6361~~	~~(4)~~	~~4423~~	~~(3)~~	~~5234~~	~~(5)~~
~~T021+T022~~	~~6543~~	~~(1)~~	~~5827~~	~~(1)~~	~~5971~~	~~(1)~~	~~4212~~	~~(3)~~	~~4587~~	~~(2)~~
~~T021+T023~~	~~6490~~	~~(1)~~	~~5777~~	~~(1)~~	~~5923~~	~~(1)~~	~~4202~~	~~(3)~~	~~4542~~	~~(2)~~
~~T025+T019~~	~~6187~~	~~(6)~~	~~6080~~	~~(7)~~	~~5962~~	~~(8)~~	~~4867~~	~~(3)~~	~~5373~~	~~(9)~~
~~T025+T029~~	~~7251~~	~~(1)~~	~~6519~~	~~(1)~~	~~6674~~	~~(10)~~	~~5880~~	~~(1)~~	~~5108~~	~~(5)~~
~~T025+T030~~	~~7367~~	~~(1)~~	~~6639~~	~~(1)~~	~~6683~~	~~(10)~~	~~6020~~	~~(1)~~	~~5220~~	~~(5)~~
~~T026+T029~~	~~6426~~	~~(1)~~	~~5709~~	~~(1)~~	~~5849~~	~~(1)~~	~~5123~~	~~(1)~~	~~4481~~	~~(2)~~
~~T026+T030~~	~~6560~~	~~(1)~~	~~5835~~	~~(1)~~	~~5976~~	~~(1)~~	~~5250~~	~~(1)~~	~~4599~~	~~(2)~~
~~T027+T019~~	~~7128~~	~~(3)~~	~~6396~~	~~(11)~~	~~6500~~	~~(11)~~	~~4545~~	~~(3)~~	~~4758~~	~~(9)~~
~~T027+T029~~	~~6351~~	~~(1)~~	~~5668~~	~~(1)~~	~~5825~~	~~(1)~~	~~5094~~	~~(1)~~	~~4467~~	~~(12)~~
~~T027+T030~~	~~6495~~	~~(1)~~	~~5793~~	~~(1)~~	~~5960~~	~~(1)~~	~~5223~~	~~(1)~~	~~4572~~	~~(5)~~
~~T028+T029~~	~~6452~~	~~(1)~~	~~5737~~	~~(1)~~	~~5877~~	~~(1)~~	~~5146~~	~~(1)~~	~~4510~~	~~(2)~~
~~T028+T030~~	~~6594~~	~~(1)~~	~~5863~~	~~(1)~~	~~6006~~	~~(1)~~	~~5274~~	~~(1)~~	~~4629~~	~~(2)~~
~~T031+T032~~	~~6501~~	~~(1)~~	~~5788~~	~~(1)~~	~~5918~~	~~(1)~~	~~4219~~	~~(3)~~	~~4556~~	~~(2)~~

~~Notes:~~

~~(1) 126294 PLTVLLEY 345 137451 LEEDS 3 345 2 \| TE44:L/O ATHENS-PV 345 91 secured to 1538 MWs~~

~~(2) 126294 PLTVLLEY 345 137451 LEEDS 3 345 2 \| T:34&44_CE18/UC30 secured to 1538 MWs~~

~~(3) 146754 MDTN TAP 345 146772 SHOEMTAP 138 1 \| T:77&76 secured to 707 MWs~~

~~(4) 137451 LEEDS 3 345 137453 N.SCOT99 345 2 \| B:N.S._77_TE32 secured to 1538 MWs~~

~~(5) 126294 PLTVLLEY 345 137451 LEEDS 3 345 2 \| LEEDS - HURLEY 345 301 secured to 1538 MWs~~

~~(6) 138019 KNICKERBOCKR 345 146143 KNICK_SCAP 345 SC \| T:34&44_CE18/UC30 secured to 2308 MWs~~

~~(7) 138019 KNICKERBOCKR 345 146143 KNICK_SCAP 345 SC \| OE:COOPC_34 secured to 2308 MWs~~

~~(8) 138019 KNICKERBOCKR 345 146143 KNICK_SCAP 345 SC \| T:#40&EDIC-PTN secured to 2308 MWs~~

~~(9) 126294 PLTVLLEY 345 137451 LEEDS 3 345 2 \| T:96&10 secured to 1538 MWs~~

~~(10) 130650 FRACCSC 345 130750 COOPC345 345 1 \| SB:KNICKERBOCKER345 secured to 1721 MWs~~

~~(11) 126294 PLTVLLEY 345 137451 LEEDS 3 345 2 \| T:96&4 secured to 1538 MWs~~

~~(12) 126294 PLTVLLEY 345 137451 LEEDS 3 345 2 \| SB:LEEDS345_R301 secured to 1538 MWs~~

~~Incremental UPNY-SENY N-1-1 Thermal Transfer Capability~~

Maintenance Outage	No Outage	CPV - Rock Tavern 345 kV Line	Marcy - Coopers Corners 345 kV Line	Roseton - East Fishkill 345 kV Line	Athens-Pleasant Valley 345 kV Line

T018+T019	1998	2073	1856	660	1895
T021+T022	1519	1457	1466	449	1248
T021+T023	1466	1408	1418	439	1203
T025+T019	1163	1711	1456	1104	2034
T025+T029	2226	2149	2169	2117	1769
T025+T030	2342	2269	2178	2257	1881
T026+T029	1401	1340	1344	1360	1142
T026+T030	1535	1465	1470	1487	1260
T027+T019	2103	2027	1995	782	1419
T027+T029	1326	1299	1320	1331	1128
T027+T030	1470	1423	1455	1459	1233
T028+T029	1427	1367	1371	1383	1171
T028+T030	1569	1493	1501	1511	1290
T031+T032	1476	1418	1413	455	1217

3.3.5.3 Summary of Operability Assessment

The NYISO used the assessment of flexibility in operating the system to determine the operability, such as the ability to remove transmission for maintenance, or high transfer limit under N-1-1 contingency.

Table 3-19 shows the summary of the operability assessment.

Table 3-19: Operability Summary

Segment	Project ID	Substation and Transmission Configuration	Electrical Operability		Ranking
			UPNY/SENY N-1-1	Central East N-1-1	
A	T018	Breaker-and-a-half 345 kV Rotterdam substation, foundations and structures beyond NESC standard	-	Low	Good
A	T021	Breaker-and-a-half 345 kV Princetown substation	-	Low	Good
A	T025	Breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation	-	Low	Good
A	T026	Breaker-and-a-half 345 kV Rotterdam substation	-	Low	Good
A	T027	Breaker-and-a-half 345 kV Rotterdam substation, breaker-and-a-half 345 kV Princetown substation	-	Highest	Excellent
A	T028	Breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation	-	Low	Good
A	T031	Breaker-and-a-half Princetown substation looping in all 345 kV lines, straight-bus at Rotterdam substation, no bus reconfiguration at New Scotland, new tower contingency created south of Princetown	-	Low	Good
B	T019	Foundations and structures beyond NESC standard	-	-	Good
B	T022	-	-	-	Good
B	T023	-	-	-	Good
B	T029	-	Improved N-1-1 performance due to Middletown upgrades proposed	-	Excellent
B	T030	-	Improved N-1-1 performance due to Middletown upgrades proposed	-	Excellent
B	T032	-	-	-	Good

3.3.6 Performance

For the AC Transmission ~~Need~~Needs, the performance metric is primarily concerned with maximizing energy transfer from upstate to downstate over the Central East and UPNY~~-~~/SENY interfaces. Table 3-20 and Table 3-21 list the 20-year incremental energy flows across the Central

East and UPNY/SENY interfaces for each of the projects compared to the pre-project case. The flows are from the MAPS Baseline and CES + Retirement without National CO_2 program cases.

Table 3-20: Baseline 20-year Incremental Energy (GWh)

Project ID	CENTRAL EAST	UPNY/SENY
T018+T019	28,721	27,500
T021+T022	26,420	24,699
T021+T023	26,050	24,058
T025+T019	89,669	40,642
T025+T029	72,646	27,889
T025+T030	76,301	29,734
T026+T029	23,081	15,115
T026+T030	23,806	15,905
T027+T019	61,551	40,089
T027+T029	55,818	27,524
T027+T030	56,664	28,546
T028+T029	26,361	18,984
T028+T030	26,114	19,485
T031+T032	25,775	31,841

Table 3-21: CES + Retirement without National CO2 20-year Incremental Energy (GWh)

Project ID	CENTRAL EAST	UPNY/SENY
T018+T019	52,543	34,444
T021+T022	46,260	32,657
T021+T023	45,841	32,024
T025+T019	149,696	57,394
T025+T029	128,379	46,939
T025+T030	134,174	49,003
T026+T029	38,377	22,467
T026+T030	38,812	23,187
T027+T019	104,019	47,535
T027+T029	96,623	36,942
T027+T030	96,878	38,166
T028+T029	49,548	25,394
T028+T030	44,079	24,472
T031+T032	46,711	26,718

3.3.~~6~~7 Production Cost

The NYISO calculated the system production costs for the AC Transmission Public Policy Transmission Projects. Each entry in the following tables represents the differences between the pre-project and post-project over the duration of a project's study period. The study period begins with the in-service date proposed by the Developers and ~~goes out~~extends 20 years. Entries with a dollar value are listed in 2018 millions of dollars. The discount rate used to calculate present value is 6.988% consistent with the 2017 CARIS Phase 1 database. The NYISO used scenarios to distinguish projects and to measure the robustness of project performance. Blank entries mean that a certain scenario was not a distinguishing factor for that particular project. In general, a negative value (listed in red) is a more positive outcome for the various metrics (*i.e.*, the system benefits from the reduction in production cost, lower LBMPs, and reduced emissions).

Table 3-22 through Table 3-28 shows the various results associated with the production cost analysis for each proposal:

Table 3-22: NYCA Production Cost Saving in 2018 M$

Project ID	Baseline	National CO2 Removed	High Natural Gas	Low Natural Gas	CES + Retirement w/o National CO2
		Based off Baseline			
T018+T019	(236)	(268)	(391)	(182)	(830)
T021+T022	(199)	(223)	(329)	(159)	(714)
T021+T023	(196)				(707)
T025+T019	(513)	(555)			(1,492)
T025+T029	(437)	(517)	(815)	(343)	(1,417)
T025+T030	(457)				(1,461)
T026+T029	(190)				(626)
T026+T030	(195)				(615)
T027+T019	(368)				(1,179)
T027+T029	(331)	(373)	(603)	(255)	(1,129)
T027+T030	(337)				(1,108)
T028+T029	(221)				(840)
T028+T030	(205)				(704)
T031+T032	(206)	(242)	(336)	(168)	(570)

Table 3-23: Baseline 20-Year Average LBMP Change in 2018 $M

Project	West	Genesee	Central	North	Mohawk Valley	Capital	Hudson Valley	Millwood	Dunwoodie	NY City	Long Island
T018+T019	0.43	0.41	0.43	0.44	0.47	(0.02)	(0.07)	(0.15)	(0.19)	(0.16)	(0.12)
T021+T022	0.38	0.38	0.40	0.45	0.45	0.01	(0.08)	(0.17)	(0.20)	(0.16)	(0.13)
T021+T023	0.37	0.38	0.40	0.45	0.45	(0.00)	(0.08)	(0.17)	(0.20)	(0.16)	(0.13)
T025+T019	0.97	0.90	0.84	1.29	1.04	(0.31)	(0.13)	(0.24)	(0.26)	(0.22)	(0.16)
T025+T029	0.95	0.90	0.90	1.30	1.05	(0.28)	(0.12)	(0.24)	(0.26)	(0.21)	(0.17)
T025+T030	0.97	0.92	0.91	1.31	1.06	(0.30)	(0.14)	(0.25)	(0.28)	(0.23)	(0.18)
T026+T029	0.39	0.38	0.40	0.48	0.45	0.01	(0.02)	(0.10)	(0.14)	(0.10)	(0.08)
T026+T030	0.41	0.39	0.40	0.48	0.45	0.02	(0.02)	(0.10)	(0.14)	(0.10)	(0.09)
T027+T019	0.75	0.71	0.70	0.84	0.79	(0.26)	(0.19)	(0.29)	(0.32)	(0.27)	(0.20)
T027+T029	0.67	0.66	0.67	0.83	0.78	(0.28)	(0.16)	(0.26)	(0.29)	(0.24)	(0.18)
T027+T030	0.69	0.67	0.68	0.83	0.78	(0.27)	(0.16)	(0.26)	(0.29)	(0.24)	(0.18)
T028+T029	0.43	0.44	0.46	0.58	0.55	(0.13)	(0.08)	(0.17)	(0.20)	(0.16)	(0.12)
T028+T030	0.43	0.41	0.42	0.52	0.49	(0.09)	(0.08)	(0.17)	(0.20)	(0.16)	(0.12)
T031+T032	0.37	0.37	0.38	0.44	0.46	0.06	(0.16)	(0.27)	(0.30)	(0.25)	(0.19)

Table 3-24: CES + Retirement Without National CO2 20-Year Average LBMP Change in 2018 $M

Project	West	Genesee	Central	North	Mohawk Valley	Capital	Hudson Valley	Millwood	Dunwoodie	NY City	Long Island
T018+T019	1.65	1.89	1.96	2.43	2.24	(1.18)	(0.15)	(0.63)	(0.84)	(0.55)	(0.49)
T021+T022	1.41	1.60	1.66	2.04	1.92	(0.66)	(0.10)	(0.57)	(0.79)	(0.49)	(0.46)
T021+T023	1.39	1.60	1.65	2.06	1.92	(0.71)	(0.11)	(0.57)	(0.79)	(0.49)	(0.46)
T025+T019	3.09	3.58	3.58	4.80	4.06	(2.31)	(0.62)	(1.19)	(1.37)	(0.92)	(0.83)
T025+T029	2.94	3.42	3.47	4.64	3.92	(2.21)	(0.65)	(1.22)	(1.40)	(0.93)	(0.85)
T025+T030	3.05	3.55	3.60	4.82	4.06	(2.34)	(0.70)	(1.27)	(1.45)	(0.97)	(0.88)
T026+T029	1.26	1.41	1.47	1.74	1.70	(0.31)	0.02	(0.46)	(0.69)	(0.41)	(0.37)
T026+T030	1.25	1.38	1.44	1.69	1.66	(0.32)	0.02	(0.45)	(0.68)	(0.41)	(0.37)
T027+T019	2.40	2.78	2.83	3.63	3.21	(1.91)	(0.46)	(0.97)	(1.17)	(0.80)	(0.72)
T027+T029	2.27	2.67	2.74	3.56	3.15	(1.82)	(0.43)	(0.96)	(1.15)	(0.77)	(0.71)
T027+T030	2.25	2.63	2.69	3.50	3.09	(1.91)	(0.45)	(0.96)	(1.15)	(0.77)	(0.72)
T028+T029	1.58	1.85	1.94	2.44	2.26	(0.76)	(0.10)	(0.59)	(0.80)	(0.50)	(0.46)
T028+T030	1.38	1.55	1.61	1.95	1.87	(0.42)	(0.02)	(0.50)	(0.73)	(0.44)	(0.40)
T031+T032	1.38	1.59	1.68	2.08	2.02	(1.62)	(0.14)	(0.62)	(0.83)	(0.62)	(0.55)

Table 3-25: Baseline 20-Year Total Load Payment Change in 2018 $M

Project	West	Genesee	Central	North	Mohawk Valley	Capital	Hudson Valley	Millwood	Dunwoodie	NY City	Long Island
T018+T019	143	92	156	40	131	(16)	(42)	(11)	(32)	(238)	(77)
T021+T022	127	85	147	41	106	45	(7)	(12)	(33)	(234)	(78)
T021+T023	124	84	147	41	106	43	(7)	(11)	(32)	(232)	(78)
T025+T019	320	189	301	119	344	(128)	(110)	(16)	(42)	(305)	(93)
T025+T029	303	186	312	120	325	(111)	(24)	(15)	(40)	(282)	(93)
T025+T030	310	190	318	121	331	(117)	(45)	(16)	(42)	(301)	(97)
T026+T029	128	84	145	44	135	6	5	(7)	(23)	(163)	(55)
T026+T030	134	86	147	44	135	10	(2)	(7)	(23)	(165)	(56)
T027+T019	241	149	246	78	255	(125)	(74)	(19)	(49)	(358)	(108)
T027+T029	216	139	235	77	251	(131)	(28)	(17)	(43)	(319)	(100)
T027+T030	222	140	237	77	251	(130)	(37)	(17)	(45)	(323)	(98)
T028+T029	139	94	163	54	173	(57)	(8)	(11)	(31)	(227)	(71)
T028+T030	139	89	152	48	165	(47)	(16)	(11)	(31)	(231)	(74)
T031+T032	122	81	140	39	123	26	(24)	(18)	(44)	(326)	(103)

Table 3-26: CES + Retirement without National CO2 20-Year Total Load Payment Change in 2018 $M

Project	West	Genesee	Central	North	Mohawk Valley	Capital	Hudson Valley	Millwood	Dunwoodie	NY City	Long Island
T018+T019	496	359	609	215	339	(243)	(36)	(36)	(116)	(627)	(204)
T021+T022	429	310	522	181	286	(80)	(2)	(32)	(110)	(564)	(194)
T021+T023	424	309	521	182	287	(95)	(3)	(33)	(109)	(569)	(195)
T025+T019	903	649	1,083	425	652	(512)	(150)	(66)	(174)	(934)	(307)
T025+T029	856	620	1,048	411	623	(486)	(100)	(66)	(177)	(934)	(314)
T025+T030	885	642	1,085	428	643	(518)	(121)	(69)	(182)	(967)	(323)
T026+T029	387	277	469	154	273	(26)	19	(26)	(97)	(493)	(160)
T026+T030	385	272	460	150	268	(27)	13	(26)	(97)	(491)	(161)
T027+T019	705	509	861	322	509	(441)	(92)	(54)	(152)	(833)	(275)
T027+T029	665	489	832	316	500	(424)	(59)	(53)	(149)	(805)	(275)
T027+T030	660	481	815	310	490	(448)	(68)	(53)	(150)	(807)	(277)
T028+T029	473	351	603	217	361	(147)	1	(33)	(109)	(562)	(188)
T028+T030	419	301	510	173	309	(67)	8	(29)	(101)	(514)	(169)
T031+T032	413	299	520	184	303	(349)	1	(34)	(109)	(653)	(217)

Table 3-27: NYCA 20-Year Total Demand Congestion Change in 2018 M$

Project ID	Baseline	National CO2 Removed	High Natural Gas	Low Natural Gas	CES + Retirement w/o National CO2
		Based off Baseline			
T018+T019	(1,556)	(1,991)	(2,578)	(1,405)	(6,863)
T021+T022	(1,253)	(1,597)	(2,126)	(1,089)	(5,629)
T021+T023	(1,233)				(5,661)
T025+T019	(2,959)	(3,820)			(11,851)
T025+T029	(2,675)	(3,598)	(4,707)	(2,364)	(11,363)
T025+T030	(2,801)				(11,837)
T026+T029	(1,355)				(4,831)
T026+T030	(1,385)				(4,749)
T027+T019	(2,576)				(9,633)
T027+T029	(2,333)	(3,003)	(3,958)	(2,088)	(9,292)
T027+T030	(2,369)				(9,194)
T028+T029	(1,683)				(6,499)
T028+T030	(1,575)				(5,336)
T031+T032	(1,369)	(1,935)	(2,636)	(1,184)	(5,733)

Table 3-28: System 20-Year Total CO2 Emission Change (1000 tons)

Project ID	Baseline	National CO2 Removed	High Natural Gas	Low Natural Gas	CES + Retirement w/o National CO2
		Based off Baseline			
T018+T019	1,150	(2,476)	441	678	(4,686)
T021+T022	1,111	(1,285)	(240)	628	(7,298)
T021+T023	1,306				(8,235)
T025+T019	3,239	5,215			(15,416)
T025+T029	7,570	7,499	20,356	4,160	(11,656)
T025+T030	8,424				(11,524)
T026+T029	2,211				(6,231)
T026+T030	1,943				(6,908)
T027+T019	2,474				(10,661)
T027+T029	2,616	1,163	8,629	863	(9,429)
T027+T030	2,128				(10,184)
T028+T029	3,758				(4,056)
T028+T030	2,074				(5,901)
T031+T032	(1,724)	(6,475)	(4,868)	(2,621)	(8,814)

3.3.~~7~~8 ICAP Benefits

The NYISO calculated a range of capacity procurement benefits for those proposals identified as Tier 1 and Tier 2 in the NYISO's initial tiered-ranking. The benefits identified capture the long-term impact on capacity procurement costs and, when summed with the production cost savings metric, provide the total market-based economic benefits of a project. However, given the ranges of benefits developed and the precision of the estimates, the NYISO did not deem it prudent to use the ICAP benefit as a factor in differentiating projects but rather as a means to demonstrate the overall value of the selecting projects to satisfy the AC Transmission Needs.

In order to develop the capacity benefits, the NYISO utilized a methodology to optimize statewide capacity procurement costs that mirrors the methodology recently approved by the NYISO's Management Committee and Board of Directors to optimize locational capacity requirements. This methodology minimizes procurement costs by removing capacity from upstate surplus zones (*i.e.*, Zones A, C, and D) and shifting capacity between the transmission-constrained zones (*i.e.*, Zones G-K) and upstate, observing all Emergency Transfer Criteria Interface Limits, which is consistent with the NYSRC Reliability Rules.[29] Capacity is then priced in each locality based on a set of Net Cost of New Entry (CONE) curves for each capacity region.

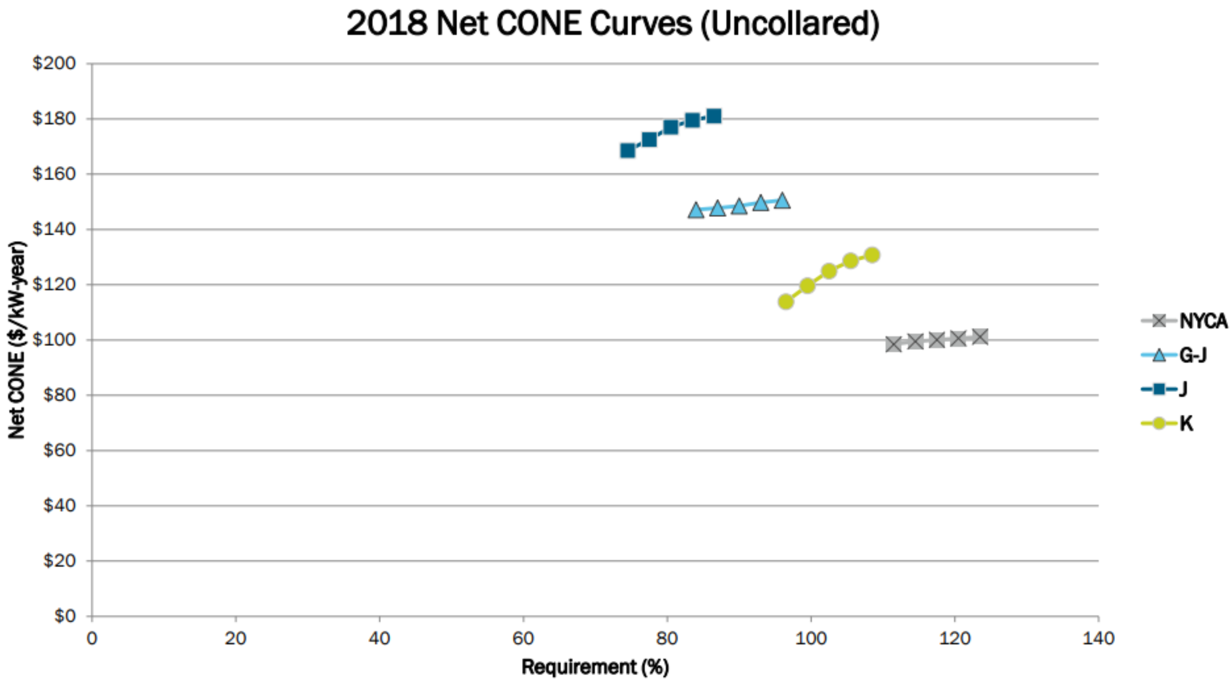
The Net CONE curves that the NYISO used in this evaluation were identical to those constructed in the NYISO's evaluation of the Alternative LCR methodology and reflect updates to the 2017 Net CONE Curves and Reference Points as shown in the Figure 3-18 below[30]:

Figure 3-18~~[*To be filled later*]~~

[29] NYSRC Reliability Rules A.1 Establishing NYCA Installed Reserve Margin Requirements.

[30] Alternative Method for Determining LCRs presentation is posted at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_icapwg/meeting_materials/2018-02-06/ICAPWG_2-06-18_AlternativeMethodsforLCRs_Final.pdf

~~3.3.8~~: 2018 Net CONE Curves



In order to calculate the change in "optimized" procurement costs between the pre-project and post-project cases, the NYISO determined the change in emergency transfer limits for key interfaces impacted by Tier 1 and Tier 2 projects through transfer limit analyses of representative project combinations. These analyses yielded the following increases in emergency transfer limits:

- For the UPNY/SENY interface, increases ranged from 1,150 MW to 1,400 MW
- For the Zone F to Zone G interface, increases ranged from 1,275 MW to 1,325 MW
- For the UPNY-Con Ed interface, increases ranged from 225 MW to 350 MW

The NYISO then utilized the optimization methodology to calculate a pre-project procurement costs and post-project procurement costs for sample years in the study period (*i.e.*, 2025, 2030, 2035, and 2040) for two cases to represent the range in increased emergency transfer limits. These pre- and post-projects results were utilized to calculate a range of impacts for each case, by year and by region (NYCA, Zones A-F, and Zones G-K). These results are as follows:

- NYCA annual savings ranged from $79M to $86M across the four study years and two cases studied, with an average savings of $80M
- Zones A-F annual increases were less than $9M, with an average increase of $4M
- Zones G-K annual savings ranged from $79M to $90M, with an average savings of $84M

Given the narrow range of annual savings values estimated, the NYISO opted to construct a 20-year time-series of annual savings values using the simple average of the four study years for each case. The annual values were escalated by 1.92% to reflect growth in Net CONE, based on the 2018/2019 escalator used to escalate the NYISO's Demand Curves, and discounted by 6.988% (as in the production cost savings metric) in order to calculate a stream of benefits in 2018 dollars.

One underlying assumption of the primary analysis is that capacity prices would converge to Net CONE beginning in 2023 (from approximately 33% of Net CONE in 2018). Recognizing that the pace at which the clearing prices approached Net CONE would be a key factor in estimating the ICAP benefit, the NYISO created an alternate calculation in which it was assumed that the capacity prices would gradually increase relative to Net CONE and converge to Net CONE by the end of the study period in 2042.

Using this optimization methodology and a range of model and analysis assumptions, the Net Present Value of Capacity Market procurement costs for the NYCA were estimated to decrease in the range of $550M to $850M for all combinations of Tier 1 and Tier 2 projects for the 20-year study period.

While the NYISO views these values as reasonable orders of magnitude estimates, the NYISO cautions that this assessment is a long-term planning analysis and is not intended to represent a forecast of future capacity requirements or prices. This is reinforced by the limited adjustments of Net CONE through this study period; applying a single escalation factor across all the Net CONE values for all localities; and not adjusting the net CONE curves for changes in Energy and Ancillary Services revenues or the gross CONE as could occur through time due to shifts in technology and market conditions.

In summary, the NYISO continues to develop its ICAP benefit metric methodology, and therefore, it did not use this metric to distinguish among projects. However, the range of $550M to $850M in ICAP savings supports the NYISO staff's recommendation that the Board of Directors approve this report recommending selection of transmission projects to meet the AC Transmission Needs as such selection would be consistent with the NYISO's markets and the interests of consumers.

3.3.9 Property Rights and Routing

For each project, the NYISO reviewed whether the Developer already possesses the right of way (ROW) necessary to implement the project or has specified a plan or approach for determining routing and acquiring property rights. In assessing the availability of real property rights for each proposed project, the NYISO relied on ~~its independent consultant,~~ SECO, along with the knowledge of ~~the New York State Department of Public Service (~~DPS~~)~~ and factual information provided by the Transmission ~~Owner(s)~~Owners in the applicable Transmission ~~District(s).~~Districts. The NYISO and SECO also reviewed, in consultation with the DPS, transmission routing studies provided by Developers that identified potential routing alternatives and land-use or environmentally sensitive areas, such as wetlands, agriculture, and residential areas.

SECO reviewed the Developers' property rights acquisition plans associated with the proposals using the Developers' projects information submitted in the Viability and Sufficiency Assessment process and responses provided by Developers to requests for additional information relating to property rights and transmission siting. Additionally, the NYISO and SECO consulted with a third-party consultant to understand the viability of Developer's property rights acquisition plans, and determined that there are no legal obstacles to incumbent and non-incumbent ~~Developer~~Developers obtaining the right to use existing ROWs and easements owned by incumbent utilities at commercially reasonable rates.

SECO found that the following items were common among all proposals in their property rights:

- All Developers propose to use existing ROW for their transmission facilities.
- Some additional real estate is required for new substation construction at Princetown Junction:
  - NextEra's project (T021) proposes a new Greenfield site located between Princetown Junction and Rotterdam, and has an option to purchase the real estate for the substation.
  - ITC's project (T031) proposes a larger substation at Princetown Junction compared to the substations proposed by other projects, and will require additional property acquisition.
- All Developers have completed preliminary routing of their proposed lines.
- All Developers have documented plans to obtain site control.

All of the non-incumbent Developers claim the following two common rights to assist in obtaining property:

- Developers cite the December 2015 Order to obtain access to the incumbent utility ROW. In that order, the PSC stated its expectation that incumbent transmission owners will act in a reasonable manner to negotiate access to and usage of their ROWs for the selected transmission project.
- If negotiations with the incumbent transmission owners or the private land owners are

unsuccessful, Developers have asserted that ~~they believe that~~ under New York State Law, they would have or obtain eminent domain authority after certification of a route by the PSC.

SECO also reviewed Developers' proposals for routing their transmission lines and substations to identify where new property rights would need to be acquired. SECO derived estimates for property from recent comparable sales and tax assessments in the town and county where the property would be located.

All Developers propose to utilize existing incumbent transmission owner-owned property and ROW with the following exceptions:

- All proposals for Segment A with the exception of NAT/NYPA Double Circuit Alternative T027 proposal will likely require the acquisition of easements to meet ~~EMF~~electric and magnetic field (EMF) guidelines in the Princetown Junction to New Scotland corridor. NYPA/NAT's T025 765 kV line conversion also requires additional easements to meet EMF guidelines.
- *De minimis* property rights may be required for construction laydown area and access, tree trimming or danger tree clearing.
- Development of a new substation at the Princetown Junction may require additional property or easements:
    - ~~Proposals~~ T018 and T026 do not include a substation at Princetown Junction.
    - ~~NextEra proposal~~ T021 proposes to build the substation at Princetown Junction on a new Greenfield site for which they have obtained an option to acquire.
    - ~~Proposal~~ T031 proposes to tie all seven lines into a substation at Princetown Junction, which will require additional property.
    - ~~Proposals~~ T025, T027, and T028 propose smaller substations at Princetown Junction with four breaker ring bus arrangements or GIS equipment that may fit in the existing property. Although it appears that placing these stations on the site is possible, the review team has identified this as a potential risk that will need to be carefully considered and potentially mitigated during detailed engineering and licensing development.

PSC policy limits the electrical and magnetic fields that may be produced by a transmission line. The maximum limits at the edge of the right of way for the electrical field is 1.6 kilovolts per meter (kV/m)[31] and for the magnetic field is 200 milligauss (mG).[32] The existing transmission line corridor (345 kV Lines #14 and #18, and 115 kV Line #13 are located on that corridor) between Princetown Junction and New Scotland Substation is currently estimated to exceed PSC standards for EMF levels. Although the proposed designs may actually improve existing levels on this transmission corridor, current Article VII regulations will require that any project, proposing upgrades on the corridor, correct the exceedance to comply with current standards. Calculations provided by the Developers are preliminary in nature and will have to be confirmed during detailed engineering design. The findings might require purchasing additional EMF easements from property owners along the ROW between Princetown and New Scotland. **Table 3-29** and

Table **3-30** show a summary of SECO's review ~~on~~of property rights acquisitions and the property requirements to mitigate EMF for all of the Segment A and Segment B proposals. A detailed analysis on property right analysis and routing can be found in Appendix D of this study report.

[31] The applicable electric field strength standards established by the PSC are set forth in Opinion No. 78-13 (issued June 19, 1978).

[32] The magnetic field standards established by the PSC are set forth in the PSC's Interim Policy Statement on Magnetic Fields, issued September 11, 1990. This statement also reaffirmed the electric field strength standards set in Opinion No. 78-13.

~~Table -: Summary of Property Rights Acquisitions & Requirements – Segment A~~

~~Project ID~~	~~Summary of Property Rights Acquisition~~	~~Substation Property Requirements~~				
		~~Substation~~	~~County~~	~~Owner~~		~~EMF Mitigation (Width in Feet)~~
				~~Incumbent Utility (Acres)~~	~~Non-Utility (Acres)~~	
~~T018~~	~~• NGrid completed routing study~~ ~~• Project ROW is fee-owned by, or under the control (via easement or permit) of, NGrid.~~ ~~• NGrid will transfer ownership of all assets to Transco.~~	~~Rotterdam Substation (Extension)~~	~~Schenectady~~	~~2.6~~	~~0~~	~~10~~
~~T021~~	~~• NextEra has an option to purchase property for the proposed Princetown Substation.~~ ~~• Would use existing ROW, owned by the incumbent utility.~~ ~~• Has a well-documented plan to obtain property and site control~~	~~Princetown Substation (New)~~	~~Schenectady~~	~~0~~	~~24.0~~	~~10~~
~~T025~~	~~• NAT/NYPA would use existing ROW, owned by the incumbent utility.~~ ~~• Does not yet possess the required ROWs.~~ ~~• Has a well-documented plan to obtain property and site control~~ ~~• NYPA to lead negotiations with the NYTO's in negotiating and obtaining easements.~~	~~Knickerbocker Substation (New)~~	~~Rensselaer~~	~~30.0~~	~~0~~	~~8 - 25~~
		~~Princetown Substation (New)~~	~~Schenectady~~	~~3.0~~	~~0~~	
		~~Rotterdam Substation (New)~~	~~Schenectady~~	~~7.5~~	~~0~~	
~~T026~~	~~Same as T025~~	~~Rotterdam Substation (New)~~	~~Schenectady~~	~~7.5~~	~~0~~	~~10~~
~~T027~~	~~Same as T025~~	~~Edic Substation (Extension)~~	~~Oneida~~	~~1.3~~	~~0~~	~~0~~
		~~Princetown Substation (New)~~	~~Schenectady~~	~~3.0~~	~~0~~	
		~~Rotterdam Substation (New)~~	~~Schenectady~~	~~7.5~~	~~0~~	
~~T028~~	~~Same as T025~~	~~Princetown Substation (New)~~	~~Schenectady~~	~~3.0~~	~~0~~	~~10~~
		~~Rotterdam Substation (New)~~	~~Schenectady~~	~~7.5~~	~~0~~	
~~T031~~	~~• ITC would use existing ROW, owned by the incumbent utility.~~ ~~• Would likely require additional property to construct the proposed Princetown Substation.~~ ~~• Has a well-documented plan to obtain property and site control.~~	~~Princetown Substation (New)~~	~~Schenectady~~	~~5.5~~	~~2.6~~	~~10~~
		~~Rotterdam Substation (Extension)~~	~~Schenectady~~	~~2.5~~	~~0~~	

Table 3-29: Summary of Property Rights Acquisitions & Requirements – Segment ~~B~~A

Project ID	Summary of Property Rights Acquisition	Substation Property Requirements					Ranking
		Substation	County	Owner		EMF Mitigation (Width in Feet)	
				Incumbent Utility (Acres)	Non-Utility (Acres)		
T018	• NGrid completed routing study	Rotterdam Substation (Extension)	Schenectady	2.6	0	10	Good

~~T019~~	~~• NGrid completed routing study~~ • Project ROW is fee-owned by, or under the control (via easement or permit) of, NGrid. ~~• NGrid will transfer ownership of all assets to Transco.~~	~~Knickerbocker Substation (New)~~	~~Rensselaer~~	~~14~~	~~0~~	~~0~~	
	• NGrid will transfer ownership of all assets to Transco.	~~Churchtown Substation (Extension)~~	~~Columbia~~	~~11.4~~	~~0~~		
		~~Pleasant Valley Substation (Extension)~~		~~Dutches~~	~~1.4~~	~~0~~	
~~T022~~T021	• NextEra ~~have~~has an option to purchase property for the proposed Princetown Substation. ~~• Would use existing ROW, owned by the incumbent utility.~~ ~~• Has a well-documented plan to obtain property and site control~~	~~Knickerbocker~~Princetown Substation (New)	~~Rensselaer~~Schenectady	~~14~~ 0	~~0~~24	10	Good
	• Would use existing ROW, owned by the incumbent utility.	~~Churchtown Substation (Extension)~~	~~Columbia~~	~~5.5~~	~~0~~		
~~T023~~	~~Same as T022~~• Has a well-documented plan to obtain property and site control	~~Knickerbocker Substation (New)~~	~~Rensselaer~~	~~14~~	~~0~~	~~0~~	
		~~Churchtown Substation (Extension)~~		~~Columbia~~	~~5.5~~	~~0~~	
T025~~T029~~	• NAT/NYPA would use existing ROW, owned by the incumbent utility. • Does not yet possess the	Knickerbocker Substation (New)	Rensselaer	~~14~~30	0	~~0~~8 to 25	Fair
		~~Churchtown~~Princetown Substation (~~Extension~~New)	~~Columbia~~Schenectady	~~11.4~~3	0		

	required ROWs. • Has a well-documented plan to obtain property and site control • NYPA to lead negotiations with the NYTO's in negotiating and obtaining easements.	Rotterdam Substation (New)	Schenectady	7.5	0		
T026~~T030~~	Same as ~~T029~~T025	~~Knickerbocker~~Rotterdam Substation (New)	~~Rensselaer~~Schenectady	~~14~~7.5	0	~~0~~10	Good
T027	Same as T025	~~Churchtown~~Edic Substation (Extension)	~~Columbia~~Oneida	~~11.4~~1.3	0	0	Good
		Princetown Substation (New)	Schenectady	3	0		
		Rotterdam Substation (New)	Schenectady	7.5	0		
T028	Same as T025	Princetown Substation (New)	Schenectady	3	0	10	Good
		Rotterdam Substation (New)	Schenectady	7.5	0		
~~T032~~T031	• ITC would use existing ROW, owned by the incumbent utility. • Would likely require additional property to construct the proposed Princetown Substation. • Has a well-documented plan to obtain property and site control.	~~Knickerbocker~~Princetown Substation (New)	~~Rensselaer~~Schenectady	~~20~~5.5	~~0~~2.6	~~0~~10	Fair
		~~Churchtown~~Rotterdam Substation (Extension)	~~Columbia~~Schenectady	~~0.3~~2.5	0		

Table 3-30: Summary of Property Rights Acquisitions & Requirements – Segment B

Project ID	Summary of Property Rights Acquisition	Substation Property Requirements					Ranking
		Substation	County	Owner		EMF Mitigation (Width in Feet)	
				Incumbent Utility (Acres)	Non-Utility (Acres)		

T019	• NGrid completed routing study • Project ROW is fee-owned by, or under the control (via easement or permit) of, NGrid. • NGrid will transfer ownership of all assets to Transco.	Knickerbocker Substation (New)	Rensselaer	14	0	0	Good
		Churchtown Substation (Extension)	Columbia	11.4	0		
		Pleasant Valley Substation (Extension)	Dutches	1.4	0		
T022	• NextEra have an option to purchase property for the proposed Princetown Substation. • Would use existing ROW, owned by the incumbent utility. • Has a well-documented plan to obtain property and site control	Knickerbocker Substation (New)	Rensselaer	14	0	0	Good
		Churchtown Substation (Extension)	Columbia	5.5	0		
T023	Same as T022	Knickerbocker Substation (New)	Rensselaer	14	0	0	Good
		Churchtown Substation (Extension)	Columbia	5.5	0		
T029	• NAT/NYPA would use existing ROW, owned by the incumbent utility. • Does not yet possess the required ROWs. • Has a well-documented plan to obtain property and site control • NYPA to lead negotiations with the NYTO's in negotiating and obtaining easements.	Knickerbocker Substation (New)	Rensselaer	14	0	0	Good
		Churchtown Substation (Extension)	Columbia	11.4	0		
T030	Same as T029	Knickerbocker Substation (New)	Rensselaer	14	0	0	Good
		Churchtown Substation (Extension)	Columbia	11.4	0		
T032	• ITC would use existing ROW, owned by the incumbent utility. • Would likely require additional property to construct the proposed Princetown Substation. • Has a well-documented plan to obtain property and site control.	Knickerbocker Substation (New)	Rensselaer	20	0	0	Good
		Churchtown Substation (Extension)	Columbia	0.3	0		

Table 3-31

~~3.3.9~~: **Summary of Property Rights**

Segment	Project ID	Property Rights	Ranking
A	T018	-	Good
	T021	Non-utility property needed for Princetown but with an option to purchase	Good
	T025	-	Fair
	T027	-	Good
	T028	-	Good
	T026	-	Good
	T031	Non-utility property needed for Princetown	Fair
B	T019	-	Good
	T022	-	Good
	T023	-	Good
	T029	-	Good
	T030	-	Good
	T032	-	Good

3.3.10 Potential Construction Delay

The NYISO initially evaluated Developers' schedules for project completion ~~first~~ as part of the Viability and Sufficiency Assessment to determine whether projects were feasible. During the evaluation stage, the NYISO conducted a more in-depth analysis of the project schedules of the viable and sufficient transmission projects to determine the accuracy of schedules provided to the NYISO and the likelihood of project delay. For this purpose, the NYISO used the more detailed engineering and design information as required ~~in~~by Section 31.4.8.1.7 of the OATT.

~~The NYISO contracted~~ SECO ~~to evaluate~~evaluated the development schedules for each proposed Public Policy Transmission Project for potential construction delay. SECO focused on the proposed durations of the tasks in each Developer's project schedule. Based on this evaluation, SECO independently determined its own time estimates for each project schedule and compared it to the Developer's proposed project duration. SECO conducted this evaluation ~~based on~~using its expertise and experience with transmission lines and substation projects in New York State and by using comparisons to actual projects that completed the Article VII process. Appendix D provides greater details on the evaluation of the project schedules.

Summary results of the evaluation of the project schedules are presented in Table 3-32. The independent minimum duration was calculated using what SECO determined to be the minimum duration for Article VII application preparation, the anticipated time for the Article VII approval process, ROW procurement where significant, and the anticipated time for construction of the project. The independent minimum duration is the best case and is shown for comparative purposes. The independent duration includes some float to the schedule to establish a reasonable schedule recognizing the potential for minor delays for the purpose of determining the in-service date once a project is selected. SECO recommended adding ~~founr~~four (4) months to each minimum schedule to account for the following ~~float~~additional time requirements:

- Two months to the construction schedule for each proposal to account for typical slippage of construction activities (*i.e.,* potential weather events, delays if construction crews are needed to respond and provide storm support, unanticipated material and equipment issues, and inability to obtain outages on a timely basis); and
- Two months to the schedule for additional licensing and permitting activities between the PSC issuing the Article VII Certificate and the submittal of the Environmental Management & Construction Plan (EMCP) to account for possible delays in submitting the EMCP should the PSC require changes to the plan submitted in the application.

Table 3-32: Results of Evaluation of the Projects Schedules

Segment	Project ID	Independent Minimum Duration Estimate: Months	Independent Duration Estimate: Months
A	T018	48	52
	T021	48	52
	T025	50	54
	T026	48	52
	T027	51	55
	T028	48	52
	T031	48	52
B	T019	45	49
	T022	43	47
	T023	45	49
	T029	45	49
	T030	45	49
	T032	47	51

3.3.~~10~~11 Potential Risks to Project Completion

~~The NYISO contracted~~ SECO ~~to evaluate~~evaluated any potential risks associated with the individual proposals that might affect the project completion ~~as per schedule~~under the development schedules in addition to those identified by the developers in their proposals. The significant drivers to the individual project risks ~~considered~~ were:

- Article VII review approval process and potential environmental issues, including visual impact
- Procurement of major equipment
- Real Estate acquisition
- Construction
- Other risks to project siting or operation

Section 4.3 of the ~~SECO's~~SECO report attached as Appendix C to this study report provides a detailed risk analysis ~~performed by SECO.~~for each proposal. It also shows all of the risks in common for all ~~the~~ projects and also project specific risks that may distinguish each project from the other projects. Table 3-36 summarizes the significant risks associated with each project. T019, T025, T031, and T032 each have specific risks relative to other projects, as discussed below.

Discussion on Article VII related issues:

T019 introduced a potential subsynchronous resonance (SSR) risk to the operation of its facilities caused by interactions between the proposed 50% series compensation and nearby synchronous generators. Transient torque may be induced on the generators in the vicinity by system disturbances, and could lead to a catastrophic event that could damage the generator-turbine shaft. Diagnosing such events requires highly specialized expert knowledge and technology. To prevent catastrophic events that damage the generator shaft, special protection schemes can be designed and installed on the generators in the vicinity, if necessary. Such significant SSR risk can be assessed by screening and performing a frequency scan analysis; however, it is difficult to fully anticipate other potential impacts to generator operation and maintenance. In addition, the installation of the series compensation may require further sub-transient evaluation for voltage recovery to ensure enough interruption capacity from circuit breakers, and may require extensive relay and protection upgrades beyond the substations in the immediate vicinity.

T025, which proposes a 765 kV design, needs potential mitigation for clearance and corona issues and hardware replacement for insulation. Moreover, the 765 kV project introduces additional siting and permitting risks due to adding up to eight new large towers and larger conductors, creating potentially significant visual impact issues. Finally, increasing the operation of the existing and new facilities to 765 kV creates EMF compliance risks and operational risks to the power system that would be caused by the size of the electric contingency resulting from an outage of that size transmission facility.

Transmission line crossings and paralleling of natural gas pipelines may require grounding or other mitigation measures. Natural gas pipeline entities are increasingly aware of such issues and are demanding mitigation measures to be installed by transmission utilities. The proposed location for the Rotterdam 345 kV substation would require relocation of a short section of the existing gas pipelines for T025, T026, T027, and T028. The minor risk and the cost associated with the gas pipeline relocation has been incorporated into the overall project cost estimates.

Because of the large footprint required for the Princetown Junction Substation in T031, it will need additional property acquisition since the proposed design will not fit within the existing National Grid ROW. The proposed substation is located close to existing homes and buildings, and the need to purchase additional property may result in delays associated with obtaining regulatory approvals and increased costs.

The triple-circuit design between Churchtown and Pleasant Valley substations in T032 makes the operation and maintenance complex. Specifically, future maintenance of the triple-circuit transmission circuits and associated structures may depend on the outage availability of all of the three circuits.

Typically, visual impacts are categorized as minor, moderate, or significant/major with regard to how project structures may be seen from sensitive receptors (*i.e.*, parks, trails, scenic roads, and historic sites) and overall community/neighborhood character. Visual assessments of the proposed transmission lines may also be required for the design and siting processes, which would include visual simulations and viewshed maps. Many factors affect the visibility and visual impact of the proposed lines, including surrounding vegetation, presence of existing lines, topography, land use, structure design, and the number of structures. If the line is determined to impact scenic resources or is not compatible with the character of the community, the line configuration could require modifications during final design to reduce the visual impact. The type of structure will affect its visibility with lattice-type towers having the highest potential visual impact. None of the Developers propose to construct lattice towers, and most of the structures being removed are lattice towers. All Developers have proposed the use of steel or concrete monopole and H frame structures. Since all of the proposed projects are essentially using the same existing ROW, with the exception of the 765 kV portion of T025 proposal, the remaining variable for evaluating potential visual impact is the structure height and number of structures. In its December 2015 Order, the PSC concluded that height increases of less than 25 feet over existing structures will not create an "adverse impact of a regional nature that would significantly impair the physical visual character of the Hudson Valley and its communities."[33] However, the construction of new structures, even with minimal increase in height, may result in siting challenges due to their potential local visual impact. The PSC determined that the local visual impacts will be addressed in the Article VII siting proceedings.[34]

Segment A: The height of the structure may increase its visibility and, therefore, potentially increase the visual impact. The following

Table 3-33 summarize the estimated difference in height of the existing structures that would be removed and proposed structures for the Segment A projects. Green highlights in the table below represent that there would likely be no visual impact due to height of the proposed structures. When structures are replaced, height increases over 10 feet are typically classified as "severe" visual impacts, absent a viewshed analysis.

Table 3-33: Number and Height of Structures for the Segment A Projects

	Number of Structures					
	T018	**T021**	**T025**	**T026/T028**	**T027**	**T031**
1. Less than 0 ft.	62	0	269	269	19	28
2. Same Ht.	9	0	7	7	11	581
3. From 0.1ft to 5 ft.	30	3	51	51	76	69
4. From 5.1 ft to 10 ft.	56	5	33	33	5	10
5. From 10.1 ft to 15 ft.	72	45	35	34	47	0
6. From 15.1 ft to 20 ft.	97	72	65	66	40	2
7. From 20.1 ft to 25 ft.	74	490	38	38	69	1
8. From 25.1 ft to 30 ft.	68	67	9	9	204	0
9. From 30.1 ft to 40 ft.	52	67	18	18	95	0
10. From 40.1 ft to 50 ft.	21	21	10	9	34	0
11. From 50.1 ft to 60 ft.	23	4	6	1	22	0
12. From 60.1 to 70 ft.	8	1	1	0	1	0
13. From 70.1 to 80 ft.	2	1	1	1	4	0
14. From 80.1 to 90 ft.	0	0	5	0	4	0
15. From 90.1 to 100 ft.	1	0	3	1	0	0
16. From 100.1 to 110 ft.	0	0	0	0	0	0

33 December 2015 Order, at p 35.

34 *See id.*

17. From 110.1 to 120 ft.	0	0	2	0	0	0
Total	575	776	553	537	631	691

	Percent of Structures					
-	T018	T021	T025	T026/T028	T027	T031
1. Less than 0 ft.	10.8%	0.0%	48.6%	50.1%	3.0%	4.1%
2. Same Ht.	1.6%	0.0%	1.3%	1.3%	1.7%	84.1%
3. From 0.1ft to 5 ft.	5.2%	0.4%	9.2%	9.5%	12.0%	10.0%
4. From 5.1 ft to 10 ft.	9.7%	0.6%	6.0%	6.1%	0.8%	1.4%
5. From 10.1 ft to 15 ft.	12.5%	5.8%	6.3%	6.3%	7.4%	0.0%
6. From 15.1 ft to 20 ft.	16.9%	9.3%	11.8%	12.3%	6.3%	0.3%
7. From 20.1 ft to 25 ft.	12.9%	63.1%	6.9%	7.1%	10.9%	0.1%
8. From 25.1 ft to 30 ft.	11.8%	8.6%	1.6%	1.7%	32.3%	0.0%
9. From 30.1 ft to 40 ft.	9.0%	8.6%	3.3%	3.4%	15.1%	0.0%
10. From 40.1 ft to 50 ft.	3.7%	2.7%	1.8%	1.7%	5.4%	0.0%
11. From 50.1 ft to 60 ft.	4.0%	0.5%	1.1%	0.2%	3.5%	0.0%
12. From 60.1 to 70 ft.	1.4%	0.1%	0.2%	0.0%	0.2%	0.0%
13. From 70.1 to 80 ft.	0.3%	0.1%	0.2%	0.2%	0.6%	0.0%
14. From 80.1 to 90 ft.	0.0%	0.0%	0.9%	0.0%	0.6%	0.0%
15. From 90.1 to 100 ft.	0.2%	0.0%	0.5%	0.2%	0.0%	0.0%
16. From 100.1 to 110 ft.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
17. From 110.1 to 120 ft.	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%

If solely based upon the height increase comparison estimates above, T031 would have the least potential adverse visual impacts by a considerable margin, but it proposes to use more structures (65 more) than all other proposals, except T021, and thus the proposal is not preferable from the perspective of visual and agriculture impacts. T021 would have the greatest potential adverse visual impact in comparison to the other proposals with 99% of the structures having a height increase of more than 10 feet. In addition, T021 proposes the greatest number of structures. T025 would have the third lowest overall potential adverse visual impact based upon the table and method discussed above. However, the most significant potential adverse visual impacts for T025 results from the height increases for the 2.5 miles of the new 765 kV transmission structures.

Segment B: **Error! Reference source not found.** below summarizes the estimated difference in height of existing structures that would be removed and proposed structures for Segment B projects. The comparison demonstrates the relative height differences for the proposed projects. Green highlights in the table below represent that there would likely be no visual impact due to height of the proposed structures. When structures are replaced, height increases over 10 feet are typically classified as "severe" visual impacts, absent a viewshed analysis.

Table 3-34: Number and Height of Structures for the Segment B Projects

	Number of Structures				
	T019	T022	T023	T029/T030	T032
1. Less than 0 ft.	87	49	6	222	240
2. Same Ht.	3	1	2	77	6
3. From 0.1ft to 5 ft.	97	58	60	44	218
4. From 5.1 ft to 10 ft.	108	181	114	44	6
5. From 10.1 ft to 15 ft.	66	116	227	12	0
6. From 15.1 ft to 20 ft.	20	0	0	3	0
7. From 20.1 ft to 25 ft.	12	0	0	1	0
8. From 25.1 ft to 30 ft.	4	0	0	0	0
9. From 30.1 ft to 40 ft.	4	0	0	0	0
10. From 60.1 ft to 70 ft.	0	0	0	2	0
Total	401	405	409	405	470

	Percent of Structures				
-	T019	T022	T023	T029/T030	T032
1. Less than 0 ft.	21.7%	12.1%	1.5%	54.8%	51.1%
2. Same Ht.	0.7%	0.2%	0.5%	19.0%	1.3%
3. From 0.1ft to 5 ft.	24.2%	14.3%	14.7%	10.9%	46.4%
4. From 5.1 ft to 10 ft.	26.9%	44.7%	27.9%	10.9%	1.3%
5. From 10.1 ft to 15 ft.	16.5%	28.6%	55.5%	3.0%	0.0%
6. From 15.1 ft to 20 ft.	5.0%	0.0%	0.0%	0.7%	0.0%
7. From 20.1 ft to 25 ft.	3.0%	0.0%	0.0%	0.2%	0.0%
8. From 25.1 ft to 30 ft.	1.0%	0.0%	0.0%	0.0%	0.0%
9. From 30.1 ft to 40 ft.	1.0%	0.0%	0.0%	0.0%	0.0%
10. From 60.1 ft to 70 ft.	0.0%	0.0%	0.0%	0.5%	0.0%

Based upon the estimates and criteria described above, T032 would have the least potential adverse visual impact due to structure height increases. However, it adds 61 (15%) more structures than any other proposed project, which could have other potential visual impacts. T029 and T030 would have the second least potential adverse visual impact with only 5% of the structures increasing in height by more than 10 feet and a reduction in the height of more than 50% of the structures.

Table 3-35: Summary of Risk analysis

Segment	Project ID	Risks: Overall Visual Impact	Risks: Easement Needed to Mitigate EMF (Acres)	Risks: Other Risks Including Siting	Risk Level
A	T018	Medium structure height increase	24	-	Medium
A	T021	High structure height increase, more structures, less impact to agriculture due to monopoles	24	-	Medium
A	T025	Low structure height increase	76	Potential mitigation for clearance and corona issues, hardware replacement for insulation, siting and permitting risks	High
A	T026	Low structure height increase	24	-	High
A	T027	High structure height increase, 6 miles of lattice tower removed, less impact to agriculture due to monopoles	0	-	Low
A	T028	Low structure height increase	24	-	Medium
A	T031	Low structure height increase, more structures, more impact to agriculture, 20 miles of lattice tower removed	24	Property acquisition for Princetown substation	Medium
B	T019	Medium structure height increase	-	Risk of SSR due to 50% series compensation	High
B	T022	Medium structure height increase	-	-	Medium
B	T023	High structure height increase	-	-	High
B	T029	Low structure height increase	-	-	Low
B	T030	Low structure height increase	-	-	Low
B	T032	Low structure height increase, more structures, more impact to agriculture, two-pole configuration with triple circuits	-	Operation and maintenance complexity due to triple-circuit design	High

The impact of this risk assessment is factored into the tiered ranking as described in Section 4.

3.3.12 Interconnection Studies

In addition, the Public Policy Transmission Planning Process considers the status and results of the interconnection studies in evaluating and selecting the more efficient or cost-effective project. All of the AC Transmission projects are currently ~~being evaluated~~ under evaluation in ~~the interconnection process. Violations could be~~their respective System Interconnection Studies in the NYISO's Transmission Interconnection Procedures under Attachment P to the NYISO's tariff. In addition, as set forth in greater detail in Section 3.4 below, violations have been preliminarily identified ~~such as~~related to transfer limit degradation between NYISO and ISO-NE~~.~~ for all proposals. The potential Network Upgrade Facilities to address ~~the~~such violations and their associated cost ~~will be considered~~are addressed in the evaluation and selection of the AC Transmission projects~~.~~ in Section 3.4. The design and cost estimates for the Network Upgrade Facilities will be finalized in the Facilities Studies for the selected projects in accordance with the Transmission Interconnection Procedures.[35]

3.4 Consequences for Other Regions

In addition to its evaluation to identify the more efficient or cost-effective solution to the ~~identified Public Policy~~AC Transmission ~~Need~~Needs, the NYISO also coordinates with neighboring regions to identify the consequences, if any, of the proposed transmission solutions on the neighboring regions using the respective planning criteria of such regions.

Through the NYISO's Transmission Interconnection Procedures ~~under Attachment P to the OATT~~ and the associated System Impact Studies currently in progress, the NYISO is consulting with the ISO-NE concerning any potential impacts due to the proposed AC Transmission ~~Need~~Needs Projects. Preliminary results from the System Impact Studies identified ~~the potential for impacts on the neighboring system from~~that each ~~of the proposed Segment B projects. Each~~ of the proposed Segment B projects potentially causes a negative impact on the export capability between the NYISO and ~~its neighboring system.~~ISO-NE. The proposed interconnection of the proposed Segment B projects, in conjunction with the proposed interconnection of Q#444 Cricket Valley Energy Center II ~~in conjunction with each of the proposed Segment B projects~~, worsened the potential export capability degradation between the NYISO and its neighboring system. ~~These impacts are considered material.~~ Therefore, in accordance with the Transmission Expansion and Interconnection Procedures, the necessary Network Upgrade Facilities will be identified in the System Impact Study to mitigate these potential issues. ~~Current~~ The NYISO's independent cost estimates include the cost of mitigating potential violations identified, such as the transfer limit degradation from NYISO to ISO-NE for all Segment B projects.

[35] To ensure potential costs are accounted for in the project cost estimates, if a proposal has preliminary Network Upgrade Facilities identified in its pending System Impact Study to resolve violations and such Network Upgrade Facilities have been agreed to by both the NYISO staff and the Connecting Transmission Owner as of the date of this draft report, a cost estimate for the Network Upgrade Facilities have been incorporated in the overall project cost estimate.

3.5 Impact on Wholesale Electricity Markets

The NYISO evaluates the impact of proposed viable and sufficient Public Policy Transmission Projects on its wholesale electricity markets, using economic metrics including change in production cost, congestion, and load payments.[36] Based on the transfer and production cost analysis results described in Sections 3.3.~~2~~3 and 3.3.~~6~~7, the proposed transmission projects all tend to increase the Central East and UPNY~~-~~/SENY transfer capability and reduce congestion. Therefore, the NYISO staff has determined that the viable and sufficient Public Policy Transmission Projects proposed to address the AC Transmission ~~Need~~Needs will have no adverse impact on the competitiveness of the New York wholesale electricity markets. Rather, the transmission projects all tend to improve the competitiveness of the NYISO's markets by increasing system transfer capability, allowing more resources and suppliers to compete to serve loads. The review from the NYISO's Market Monitoring Unit is included in Appendix E.[37]

3.6 Evaluation of Interaction with Local Transmission Owner Plans

In its Public Policy Transmission Planning Process, the NYISO is required to review the Local Transmission Owner Plans (LTPs)[38] as they relate to the BPTF to determine whether any proposed regional Public Policy Transmission Project on the BTPF can (i) more efficiently or cost-effectively satisfy any local needs driven by a Public Policy Requirement identified in the LTPs, or (ii) might more efficiently or cost-effectively satisfy the identified regional Public Policy Transmission ~~Need~~Needs than any local transmission solutions driven by Public Policy Requirements identified in the LTPs.

The Transmission Owners' current LTPs have not identified any needs driven by a Public Policy Requirement in New York State. Accordingly, the NYISO determined that there are no proposed regional Public Policy Transmission Projects that could more efficiently or cost-effectively satisfy a need driven by a Public Policy Requirement identified in an LTP. In the absence of any public policy needs in the LTPs, it is also not necessary for the NYISO to determine whether a regional transmission project would more efficiently or cost effectively satisfy such a transmission need on the BPTF than a local transmission solution.

[36] *See* OATT Sections 31.4.10 and 31.4.8.1.9.

[37] See OATT Section 31.4.11.1 ("[T]he draft report will be provided to the Market Monitoring Unit for its review and consideration").

[38] *See* Section 31.2.1.1.2.1 of the OATT.

4. Conclusions and Recommendations

In determining which of the proposed Public Policy Transmission Projects is the more efficient or cost-effective solution to satisfy the AC Transmission Needs, the NYISO staff considered each Public Policy Transmission Project's total performance under all of the selection metrics (described in Section 3 of this report), risks associated with each project, and inputs from Developers, stakeholders, and DPS. The evaluation includes scenarios that modify the assumptions to evaluate the proposed Public Policy Transmission Projects according to the selection metrics and the impact on the NYISO's wholesale electricity markets. This section describes the summary of project evaluations, ranking of projects, selection recommendation, and next steps.

4.1 Summary of Project Evaluations

The project evaluations are summarized in this section based on their individual performance. Below is a brief summary of the key design differences and the highlighted evaluation results for each of the seven Segment A projects. All Segment A projects retire the Porter to Rotterdam 230 kV lines as directed by the December 2015 Order, and since this component of the projects is not a distinguishing factor, it is not repeated in the summary below.

T018: National Grid/Transco - NYES Segment A

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, capacitor bank at Rotterdam 345 kV substation
- The independent cost estimate is $520 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability, and foundations and structures beyond NESC standard
- Easement needed to mitigate EMF violations

T021: NextEra - Enterprise Line Segment A

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Marcy to New Scotland 345 kV line #18 looped into and out of a new Princetown 345 kV substation, and additional non-utility property needed for Princetown substation but with an option to purchase
- The independent cost estimate is $498 million
- The independent duration estimate is 52 months
- Low Central East limit increase

- Good operability and expandability
- Easement needed to mitigate EMF violations

T025: NAT/NYPA - Segment A + 765 kV

- Single Edic to New Scotland 345 kV line proposed on existing ROW, existing 345 kV line between Marcy and Knickerbocker converted to 765 kV operation, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Princetown 345 kV substation, a new Princetown substation tapping the new line and line #14, and terminal upgrades at Marcy and Edit substations
- The independent cost estimate is the highest at $863 million
- The independent duration estimate is 54 months
- High Central East limit increase, but still low N-1-1 performance
- Good operability and expandability
- The most easement needed to mitigate EMF violations, and high risks to project completion associated with clearance, corona, insulation, and siting issues

T026: NAT/NYPA - Segment A Base

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, and terminal upgrades at Marcy and Edit substations
- The independent cost estimate is the lowest at $491 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability
- Easement needed to mitigate EMF violations

T027: NAT/NYPA - Segment A Double-Circuit

- Double-circuit Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, a new Princetown substation tapping the new line and line #14, and terminal upgrades at Marcy and Edic substations
- The independent cost estimate is at $750 million
- The independent duration estimate is 55 months
- High Central East limit increase
- Excellent operability and expandability

- Minimum risk to mitigate EMF violations

T028: NAT/NYPA - Segment A Enhanced

- Single Edic to New Scotland 345 kV line proposed on existing ROW, the existing Edic to New Scotland 345 kV line #14 looped into and out of a new Rotterdam 345 kV substation, a new Princetown substation tapping the new line and line #14, and terminal upgrades at Marcy and Edit substations
- The independent cost estimate is at $514 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability
- Easement needed to mitigate EMF violations

T031: National Grid/Transco - NYES Segment A

- Single Edic to New Scotland 345 kV line proposed on existing ROW, a new Princetown substation tapping all 345 kV lines, common tower structures used for the new line and line #14 south of Princetown, two new Princetown to Rotterdam 345 kV lines proposed on existing ROW, and additional non-utility property needed for Princetown substation
- The independent cost estimate is $570 million
- The independent duration estimate is 52 months
- Low Central East limit increase
- Good operability and expandability
- Easement needed to mitigate EMF violations

All Segment B projects include the common upgrades required by the PSC in its December 2015 Order, which ordered Orange and Rockland Utilities, Inc. (O&R) and Central Hudson Gas and Electric Corporation (Central Hudson), respectively, to upgrade the Shoemaker to Sugarloaf 138 kV facilities and the terminal upgrades at Rock Tavern 345 kV Substation. These projects were not considered by the NYISO as a distinguishing factor in selecting among proposed projects. Below is a brief summary of the key design differences and the highlighted evaluation results for each of the six Segment B projects.

T019: National Grid/Transco - NYES Segment B

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW, 50% series compensation on the proposed 345 kV line, two capacitor banks proposed at Pleasant Valley, and terminal upgrades at Roseton and New Scotland substations
- The independent cost estimate is $445 million
- The independent duration estimate is 49 months
- High UPNY/SENY transfer limit increase due to series compensation
- Good operability and expandability, and foundations and structures beyond NESC standard
- Medium structure height increase, relay coordination due to series compensation, and risk of SSR and voltage rise mitigation due to series compensation

T022: NextEra - Enterprise Line Segment B

- Double-circuit Knickerbocker to Churchtown 345/115 kV line and single-circuit Churchtown to Pleasant Valley 345 kV line proposed on existing ROW, and a new Churchtown 115 kV substation proposed next to the existing one
- The independent cost estimate is the lowest at $338 million
- The independent duration estimate is 47 months
- Average UPNY/SENY transfer limit increase
- Good operability and expandability
- Medium structure height increase

T023: NextEra - Enterprise Line Segment B-Alt

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW, and a new Churchtown 115 kV substation proposed next to the existing one
- The independent cost estimate is $390 million
- The independent duration estimate is 49 months
- Average UPNY/SENY transfer limit increase
- Good operability and expandability
- High structure height increase

T029: NAT/NYPA - Segment B Base

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW, and Middletown upgrades proposed
- The independent cost estimate is $387 million
- The independent duration estimate is 49 months

- Average UPNY/SENY transfer limit increase
- Excellent operability and good expandability
- Lowest structure height increase, more than 50% of the structures with reduced height

T030: NAT/NYPA - Segment B Enhanced

- Double-circuit Knickerbocker to Pleasant Valley 345/115 kV line proposed on existing ROW with three-bundle conductors for the 345 kV line, and Middletown upgrades proposed
- The independent cost estimate is $406 million
- The independent duration estimate is 49 months
- Average UPNY/SENY transfer limit increase
- Excellent operability and good expandability
- Lowest structure height increase, more than 50% of the structures with reduced height

T032: ITC - 16NYPP1-1A AC Transmission Segment B

- Double-circuit Knickerbocker to Churchtown 345/115 kV line and triple-circuit Churchtown to Pleasant Valley 345 kV line proposed on existing ROW
- The independent cost estimate is the highest at $502 million
- The independent duration estimate is 51 months
- Average UPNY/SENY transfer limit increase
- Good operability and expandability
- Low structure height increase, but more structures used resulting in higher risk to siting due to potential visual and agricultural impacts

4.2 Ranking

A two-step process was used to rank the AC Transmission Public Policy Transmission Projects. Step 1 divided projects in each segment into three tiers based on their individual performance and risks. Step 2 ranked the projects numerically in each segment based on combination results.

4.2.1 Step 1: Tiered Ranking

Projects in each segment were first analyzed individually, and then compared against each other to identify the major performance and risk differences. Metrics analyzed in this step include independent cost estimates, duration estimates, transfer capability, operability, expandability, property rights, replacement of aging infrastructure, and risks. The remaining metrics were considered in Step 2.

Table 4-1 and Table 4-2 show the major performance and risk differences for Segment A and

Segment B projects, respectively. Both tables are color-coded such that the pros are highlighted in green and cons are highlighted in red. A dash used in the tables signifies that the project has an average performance. Based on the NYISO staff's consideration of these evaluation metrics, together with inputs from Developers, stakeholders, and DPS, the AC Transmission Public Policy Transmission Projects were divided into three tiers for each segment with Tier 1 being the most favorable and Tier 3 being the least favorable.

The objective of Segment A is to increase the Central East transfer capability by constructing new 345 kV transmission on the ROW made available through decommissioning the existing Porter to Rotterdam 230 kV lines. Compared with other Segment A projects, T027 significantly increases the Central East transfer capability, and results in excellent operability, expandability, and replacement of aging infrastructure, and has the lowest risk to mitigate EMF issues due to the double circuit EMF cancelling design. Therefore, T027 was placed in Tier 1. In contrast, though T025 has the highest Central East incremental transfer capability and average performance on other metrics, it was placed in Tier 3 because of significant risks associated with this 765 kV project design as described in Section 3.3.11. T026 was also placed in Tier 3 due to its lowest Central East incremental transfer capability. The remaining projects were placed in Tier 2 due to relatively similar performance and risks.

All Segment B projects are electrically similar except for T019 with the proposed series compensation. As a result, the NYISO identified that distinguishing factors among the Segment B projects are the structure heights and the number of structures due to the associated risks to obtaining the Article VII siting certificate based on its adverse visual impacts to the Hudson Valley.[39] In order to quantify the difference in visual impacts among projects, SECO's evaluation compares the proposed structure topology provided by the Developers to the information of the existing structures provided by the current facility owner. The differences in the structure height and the number of towers are identified and then further compared between proposals.[40]

This analysis identified that more than 50% of the new tower structures proposed by T029 and T030 have a reduced height. Therefore, T029 and T030 were placed in Tier 1 because of low

[39] While the December 2015 Order encouraged new structures to have minimal increase in height, and determined that height increases of less than 25 feet over existing structures will not be considered to be an adverse visual impact on the regional basis, the construction of new structures even with minimal increase in height may result in greater siting challenges due to their visual impact. *See* December 2015 Order, at p 35.

[40] The final project design and visual impact identification and mitigation will be addressed by the PSC in the Public Service Law Article VII siting proceedings.

structure height increase, excellent operability, and relatively low cost estimates. T022 was placed in Tier 2 because of medium structure height increase and relatively less aging infrastructure replacement. T019 was placed in Tier 3 because of its medium structure height increases and risks associated with the proposed series compensation. T023 was placed in Tier 3 because of its high structure height increases. Although T032 has low structure height increase, it was placed in Tier 3 since it adds more structures, increasing the siting risk due to potential visual and agricultural use impacts.

Table 4-1: Summary of Results for Segment A

Project ID	Independent Cost Estimate: 2018 $M	Independent Duration Estimate: Months	Incremental Central East Voltage Transfer Limit	Operability	Propriety Rights	Expandability	PSC Criterion: Replacement of Aging Infrastructure	Risks			Tiered Ranking
								Overall Visual Impact	Easement Needed to Mitigate EMF (acres)	Other Risks Including Siting	
T018	520	52	Low	Breaker-and-a-half 345 kV Rotterdam substation, foundations and structures beyond NESC standard, low N-1-1 performance	-	-	-	Medium structure height increase	24	-	2
T021	498	52	Low	Breaker-and-a-half 345 kV Princetown substation, low N-1-1 performance	Non-utility property needed for Princetown substation, but with an option to purchase	Property available to expand the Princetown substation	No upgrades at Rotterdam substation	High structure height increase, more structures, less impact to agriculture due to monopoles	24	-	2
T025	863	54	Highest	Breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation, low N-1-1 performance	-	-	-	Low structure height increase	76	Potential mitigation for clearance and corona issues, hardware replacement for insulation, siting, and permitting risks, and risk to system operations due to contingency size	3
T026	491	52	Lowest	Breaker-and-a-half 345 kV Rotterdam substation, low N-1-1 performance	-	-	-	Low structure height increase	24	-	3
T027	750	55	High	breaker-and-a-half 345 kV Rotterdam substation, breaker-and-a-half 345 kV Princetown substation, best N-1-1 performance	-	All projects allow one more 345 kV line to be added within existing ROW, but double-circuit design tends to maximize the Central East transfer capability	More replacement due to double-circuit design, rebuild of Edic - New Scotland 345 kV line #14 for 6.3 miles, terminal upgrades at Marcy and Edic 345 kV substations	High structure height increase, 6 miles of lattice tower removed, less impact to agriculture due to monopoles	0	-	1
T028	514	52	Low	breaker-and-a-half 345 kV Rotterdam substation, ring-bus 345 kV Princetown substation, low N-1-1 performance	-	-	-	Low structure height increase	24	-	2
T031	570	52	Low	Breaker-and-a-half Princetown substation looping in all 345 kV lines, straight-bus at Rotterdam substation, no bus reconfiguration at New Scotland, new tower contingency created south of Princetown, low N-1-1 performance	Non-utility property needed for Princetown substation	-	Rebuild of Edic - New Scotland 345 kV line #14 for 20 miles	Low structure height increase, more structures, more impact to agriculture, 20 miles of lattice tower removed	24	Property acquisition for Princetown substation	2

Table 4-2: Summary of Results for Segment B

Project ID	Independent Cost Estimate: 2018 $M	Independent Duration Estimate: Months	Incremental UPNY/SENY Thermal Transfer Limit	Operability	Propriety Rights	Expandability	PSC Criterion: Replacement of Aging Infrastructure	Risks		Tiered Ranking
								Overall Visual Impact	Other Risks Including Siting	
T019	445	49	Higher with series compensation, but similar to others if bypassed	Foundations and structures beyond NESC standard	-	-	Churchtown 115 kV substation rebuild, terminal upgrades at New Scotland and Roseton substations	Medium structure height increase	Risk of SSR due to 50% series compensation	3
T022	338	47	-	-	-	-	Less 115 kV upgrades between Churchtown and Pleasant Valley	Medium structure height increase	-	2
T023	390	49	-	-	-	-	-	High structure height increase	-	3
T029	387	49	-	Improved N-1-1 performance due to Middletown upgrades	-	-	Middletown upgrades, Churchtown 115 kV substation rebuild	Low structure height increase	-	1
T030	406	49	-	Improved N-1-1 performance due to Middletown upgrades	-	-	Middletown upgrades, Churchtown 115 kV substation rebuild	Low structure height increase	-	1
T032	502	51	-	-	-	Transformers could be added to connect the Knickerbocker 345kV and 115 kV switching stations	-	Low structure height increase, more structures, more impact to agriculture, two-pole configuration with triple circuits	Operation and maintenance complexity due to triple-circuit design	3

Notes:
1. With 30% contingency rate, without 5% synergy, and without cost for Rock Tavern and Shoemaker-Sugarloaf upgrades

4.2.2 Step 2: Individual Ranking

In Step 2, combinations of Segment A and Segment B projects were evaluated based on consideration of all the evaluation metrics for efficiency or cost effectiveness. Synergies of projects were identified in two factors: i) cost saving for both Segment A and Segment B projects proposed by the same Developer, and ii) the overall system efficiency or cost effectiveness based on the combined electrical characteristics, regardless of whether the projects are proposed by the same Developers or not. The combination results were then used to inform the numerical ranking in each Segment.

Table **4-3** provides a summary of Tier 1 and Tier 2 project combination results for each metric evaluated for the AC Transmission Needs.[41] The table is color-coded such that the best values are highlighted in green, average values are highlighted in yellow, and low values are highlighted in red. This table does not comprehensively summarize all evaluations documented in this report, but offers a high-level summary of the relative performance of each Tier 1 and Tier 2 project combination for each metric using the primary study assumptions. No single metric or set of assumptions acts as the single deciding factor in determining the more efficient or cost effective transmission solution.

Based on consideration of all the evaluation metrics for efficiency or cost effectiveness, together with inputs from stakeholders and DPS, the NYISO staff ranked the projects in each segment. The relative ranking was first developed by comparing project performance and risks in pairs, and then the differences were identified to distinguish the projects.

[41] Note that the combination for all possible pairs from the same Developers were evaluated and the results are included in Section 3, but in this section the results for Tier 3 projects were not summarized due to low performance and/or high risks.

Table 4-3: Summary of Evaluations

Project ID	Independent Cost Estimate: 2018 $M (1)	Independent Duration Estimate: Months (2)	UPNY/SENY Incremental Thermal Transfer Limit: MW (3)	Central East Incremental Voltage Transfer Limit: MW	UPNY/SENY Cost/MW: $M/MW (3)	Central East Cost/MW: $M/MW	Baseline Production Cost Savings: 2018 $M	Baseline Production Cost Savings /Capital Cost	CES Production Cost Savings: 2018 $M	CES Production Cost Savings /Capital Cost	System CO2 Emission Reduction: 1000 tons (4)	Performance: 20-Year Incremental Flow on UPNY/SENY + Central East: GWh (4)	Operability		Expandability		Property Rights		PSC Criterion: Aging Infrastructure		Tiered Ranking	
													Seg A	Seg B	Seg A	Seg B	Seg A	Seg B	Seg A	Seg B	Seg A	Seg B
T018+T022	858	52	1,519	425	0.22	1.22	236	0.27	830	0.97	4,686	86,987	Good	Good	Good	Good	Good	Good	Good	Fair	2	2
T018+T029	908	52	1,401	425	0.28	1.22	236	0.26	830	0.91	4,686	86,987	Good	Excellent	Good	Good	Good	Good	Good	Good	2	1
T018+T030	926	52	1,535	425	0.26	1.22	236	0.25	830	0.90	4,686	86,987	Good	Excellent	Good	Good	Good	Good	Good	Good	2	1
T021+T022	794	52	1,519	350	0.21	1.35	199	0.25	714	0.90	7,298	78,917	Good	Good	Good	Good	Good	Good	Good	Fair	2	2
T021+T029	885	52	1,401	350	0.28	1.42	196	0.22	707	0.80	8,235	77,865	Good	Excellent	Good	Good	Good	Good	Good	Good	2	1
T021+T030	904	52	1,535	350	0.26	1.42	196	0.22	707	0.78	8,235	77,865	Good	Excellent	Good	Good	Good	Good	Good	Good	2	1
T027+T022	1088	55	1,326	825	0.26	0.91	331	0.30	1129	1.04	9,429	133,565	Excellent	Good	Excellent	Good	Good	Good	Excellent	Fair	1	2
T027+T029	1080	55	1,326	825	0.28	0.86	331	0.31	1129	1.05	9,429	133,565	Excellent	Excellent	Excellent	Good	Good	Good	Excellent	Good	1	1
T027+T030	1098	55	1,470	825	0.26	0.86	337	0.31	1108	1.01	10,184	135,044	Excellent	Excellent	Excellent	Good	Good	Good	Excellent	Good	1	1
T028+T022	852	52	1,519	400	0.22	1.28	221	0.26	840	0.99	4,056	74,942	Good	Good	Good	Good	Good	Good	Good	Fair	2	2
T028+T029	856	52	1,427	400	0.26	1.22	221	0.26	840	0.98	4,056	74,942	Good	Excellent	Good	Good	Good	Good	Good	Good	2	1
T028+T030	874	52	1,569	325	0.25	1.50	205	0.23	704	0.81	5,901	68,551	Good	Excellent	Good	Good	Good	Good	Good	Good	2	1
T031+T022	908	52	1,519	400	0.22	1.43	206	0.23	570	0.63	8,814	73,429	Good	Good	Good	Good	Fair	Good	Excellent	Fair	2	2
T031+T029	957	52	1,427	400	0.27	1.43	206	0.22	570	0.60	8,814	73,429	Good	Excellent	Good	Good	Fair	Good	Excellent	Good	2	1
T031+T030	976	52	1,569	400	0.26	1.43	206	0.21	570	0.58	8,814	73,429	Good	Excellent	Good	Good	Fair	Good	Excellent	Good	2	1

Notes:
1. With 30% contingency rate, with 5% synergy if from same developers, and without cost for Rock Tavern and Shoemaker-Sugarloaf upgrades
2. Max of Segment A and Segment B
3. UPNY/SENY N-1 optimized thermal transfer
4. CES + Retirement w/o National CO_2

Critical comparisons and the resulting ranking are summarized below for the Segment A projects:

- T027, as shown in **Table 4-3**, consistently performs best regardless of which Segment B project is paired with it. While T027 has the second highest cost among Segment A projects, the overall benefits provided by the double-circuit design warrant the cost. These benefits include a significant increase in Central East transfer capability, increased production cost savings, and excellent operability and expandability. T027 also has the lowest risk to mitigate the EMF issues compared with other Segment A projects. As a result, T027 was ranked highest among all Segment A projects.
- The combinations with either T028 or T018 for Segment A have similar performance in several metrics based on representative results. T028 includes the new Princetown 345 kV substation that better integrates the existing system and provides future expandability. Moreover, T028 includes terminal upgrades at the Edic and Marcy 345 kV substations, which help reduce congestion. T028 was ranked higher than T018 for these reasons.
- The three Segment A Tier 2 projects were compared against each other. T018 has several key features, such as including a capacitor bank, looping the existing Edic to New Scotland 345 kV line #14 into the Rotterdam GIS substation, which has three proposed transformers, and the foundations and structures proposed are beyond the minimum requirement of National Electrical Safety Code (NESC). In contrast, T021 loops the existing Marcy to New Scotland 345 kV line into the Princetown substation with two proposed transformers, which causes congestion under certain system conditions. Moreover, T021 does not propose to replace the aging infrastructure at the Rotterdam substation. T031 is the most expensive among the Segment A Tier 2 projects. While T031 provides a good increase in the Central East transfer capability, it creates an additional tower contingency south of Princetown. Compared with the combinations with T021, the combinations with T031 perform less efficiently in many metrics such as cost per MW. Furthermore, T031 requires additional non-utility property for Princetown substation due to its large footprint, which poses a siting risk. Therefore, T018 ranks better than T021, and T021 ranks better than T031.
- T026 is a Tier 3 project due to the least benefits of all Segment A projects, even though it is also the least expensive.
- T025 is a Tier 3 project with the highest cost. Although it greatly increases the Central East transfer capability, it has the highest risks due to the potential siting and operations risks

associated with its 765 kV design. Therefore, it was given the lowest ranking among Segment A proposals.

Critical comparisons and the resulting ranking are summarized below for Segment B projects:

- T029 and T030, both Tier 1 projects, propose the lowest structure height increase and more than 50% of the new structures have a reduced height. Compared with other projects, they also have more replacement of aging infrastructure and better operability. Therefore, they were ranked higher among Segment B projects. The additional cost of the triple-bundle circuit proposed in T030 is less than the incremental production cost savings, and T030 is therefore less preferable. As a result, T029 was ranked higher than T030.
- T022, a Tier 2 project, is the least expensive Segment B project with medium structure height increases and relatively less aging infrastructure replacement. Therefore, it was ranked below T029 and T030.
- T023 and T019 are both Tier 3 projects. T023 has lower cost but comparatively more increases in structure height. T019 proposes medium structure height increase and stronger foundations and structures that exceed NESC standards, and also enables higher UPNY/SENY transfer capability. Accordingly, T019 was ranked higher than T023. However, as described in Section 3.3.11, this project poses risks of voltage rise, relay coordination, and subsynchronous resonance mitigation due to the proposed 50% series compensation.
- T032 is the most expensive Segment B project with numerous inherent siting risks in the design. These include additional structures with potential adverse visual and agricultural impacts, and operational and planning risk due to the triple circuit design. Accordingly, it was given the lowest ranking among Segment B proposals.

Taking all the metrics into consideration, the overall ranking of the projects in each segment is summarized in Table 4-4.

Table 4-4: Overall Ranking

Segment	Ranking	Project ID	Developer Name	Project Name
A	1	T027	North America Transmission / NYPA	Segment A Double Circuits
	2	T028	North America Transmission / NYPA	Segment A Enhanced
	3	T018	National Grid / Transco	New York Energy Solution Seg. A
	4	T021	NextEra Energy Transmission New York	Enterprise Line: Segment A
	5	T031	ITC New York Development	16NYPP1-1A AC Transmission
	6	T026	North America Transmission / NYPA	Segment A Base
	7	T025	North America Transmission / NYPA	Segment A + 765 kV
B	1	T029	North America Transmission / NYPA	Segment B Base
	2	T030	North America Transmission / NYPA	Segment B Enhanced
	3	T022	NextEra Energy Transmission New York	Enterprise Line: Segment B
	4	T019	National Grid / Transco	New York Energy Solution Seg. B
	5	T023	NextEra Energy Transmission New York	Enterprise Line: Segment B-Alt
	6	T032	ITC New York Development	16NYPP1-1B AC Transmission

4.3 Selection Recommendation

Based on consideration of all the evaluation metrics for efficiency or cost effectiveness, together with input from Developers, stakeholders, and DPS, the NYISO staff recommends that the Board of Directors selects NAT/NYPA's T027 Segment A Double-Circuit proposal and NAT/NYPA's T029 Segment B Base proposal as the more efficient or cost-effective transmission solutions to satisfy the AC Transmission Needs.

Compared with other projects, the overall benefits provided by the double-circuit design in T027 warrant the more-expensive cost. These benefits include significant increase in Central East transfer capability, increased production cost savings, and excellent operability and expandability. T027 also has the lowest EMF risk due to the EMF cancelling effect of the double circuit design. T029 provides similar UPNY/SENY transfer incremental and production cost savings with the second lowest cost. T029 also demonstrates excellent operability. Moreover, T029 is assessed to have the lowest siting risk due to the lower increases in structure height compared to other projects; in fact, more than half of its new structures will be lower than existing structure heights along the right-of-way.

Both T027 and T029 are proposed by the same Developer, NAT/NYPA, which would result in synergy cost savings when developing two projects simultaneously. The selection of T029 for

Segment B by itself will not likely result in significant production cost savings to relieve Central East congestions, but when combined with T027 for Segment A, the synergies of transmission projects lead to best overall performance across evaluation metrics. Therefore, the NYISO staff determined that T027 for Segment A and T029 for Segment B are the more efficient or cost effective transmission solutions to satisfy the AC Transmission Public Policy Transmission Needs.

The combination of T027 and T029 is estimated to cost $1,080 million, taking into consideration a 30% contingency factor and a 5% discount for cost efficiency synergies of having a single developer for both projects. The projects are expected to provide combined production cost savings and capacity procurement savings in a range of $881 million to $1,979 million depending on future system conditions. Based on the project schedule estimated by SECO, the in-service date for the selected projects is April 2023, assuming that the preparation of an Article VII application will begin immediately following the approval of this report and the selection of the projects by the NYISO Board of Directors.

4.4 Next Steps

Following the approval of this report by the NYISO Board of Directors, the NYISO will tender a Development Agreement for the selected transmission projects. The Development Agreement will reflect a project milestone schedule under which the Developer of the selected projects will complete the interconnection process, apply for Article VII siting and other necessary permits and authorizations, enter into an Operating Agreement with the NYISO, and bring the project into service.

Appendices

Appendix A – Public Policy Transmission Planning Process Glossary

Appendix B – AC Transmission Public Policy Transmission Planning Need Viability and Sufficiency Assessment

Appendix C – Phase 2 Selection Assumptions

Appendix D – SECO Report

Appendix E – Market Monitoring Unit Report

~~Appendix F – AC Transmission Project Proposals detailed descriptions~~