NYISO MMU EVALUATION OF THE PROPOSED AC PUBLIC POLICY TRANSMISSION PROJECTS

POTOMAC ECONOMICS

By:

David B. Patton, Ph.D.
Pallas LeeVanSchaick, Ph.D.
Raghu Palavadi Naga

Market Monitoring Unit
for the New York ISO

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I. Executive Summary

In accordance with Order 1000, the NYISO tariff allows for recovery of the costs of transmission projects that are built to achieve public policy requirements from New York State laws or regulations. The tariff requires NYISO to issue a report detailing its evaluation of the proposed projects and identifying which (if any) is the more efficient or cost-effective project for satisfying the Public Policy Transmission Need ("PPTN").[1] The tariff also requires the Market Monitoring Unit ("MMU") to "review and consider" any impact on the ISO-administered markets from regulated transmission solutions proposed to satisfy the PPTN, and then the MMU is to provide a report containing its evaluation to stakeholders before the Management Committee advisory vote on the Public Policy Transmission Planning Report.[2]

The NYPSC issued an order finding a Public Policy Requirement to build:

> …a portfolio of 345 kV transmission projects to reconfigure and upgrade transmission facilities from the Edic or Marcy substations to the New Scotland substation with a tie-in to the Rotterdam substation and from a new Knickerbocker substation to the Pleasant Valley substation, with upgrades at the Greenbush substation, including also upgrades to the Rock Tavern substation, and the construction of a new double circuit 138 kV line from the Shoemaker to Sugarloaf substations…

While the Public Policy Requirement identified a long list of standard wholesale market objectives such as cost savings and reliability that would be achieved by these projects, it also identified several objectives that are outside the ordinary scope of the wholesale market, including: serving more load in downstate areas from efficient and/or renewable resources upstate, promoting job growth, increasing tax receipts, and reducing generation with harmful environmental and health effects.[3]

The order stated that this leads to a Public Policy Transmission Need, which included specific upgrades that would constitute each of the projects listed in the Public Policy Requirement, where the projects involving the Edic, Marcy, New Scotland, and Rotterdam stations would be known as "Segment A" and the other projects would collectively be known as "Segment B".[4]

The order directed the NYISO to consider transmission solutions satisfying a list of a key criteria, including that Segment A should increase Central-East interface capability by at least

1 See NYISO Open Access Transmission Tariff Section 31.4.11.

2 See NYISO Market Services Tariff Section 30.4.6.8.5.

3 The full text of the Public Policy Requirement is provided in Section III.

4 The full text of the PPTN is provided in Section III.

350 MW and that Segment B should increase UPNY-SENY interface capability by at least 900 MW.[5]

Developers submitted 16 proposals for satisfying the PPTN. The NYISO found 13 that would satisfy the Viability and Sufficiency Criteria for Segment A and/or for Segment B. The NYISO performed a thorough analysis of the costs and benefits of these projects.

The NYISO estimated the overnight costs and assessed potential development risks of each project against the projected:

- Economic benefits from lower electricity production costs,
- Environmental benefits from reduced CO_2 emissions from fossil-fuel generators,
- Reliability benefits from helping satisfy planning resource adequacy requirements,
- The reduced need for fossil-fueled generation in downstate areas, and
- Other benefits from enhancing the bulk power system such as: expandability of new infrastructure, operability of transmission equipment, and retirement of aging equipment.

When evaluating the market effects of individual projects, we consider that uneconomic projects can harm the electricity markets by inefficiently altering energy and capacity prices in the short-term, crowding-out efficient market-based investment, and inflating market risks in the long-term. However, the determination of whether projects are economic must include factors that are not fully priced in the NYISO markets. Public policy projects that generate large unpriced benefits are more likely to be economic and, thus, are less likely to harm the markets. For projects that are uneconomic (i.e., whose costs exceed the priced and unpriced benefits they would produce), we consider the potential harm to the NYISO markets. This principle is discussed in more detail in Section II.A.

The remainder of this executive summary discusses our evaluation and conclusions. Section II provides a more detailed presentation of our evaluation, including an assessment of the metrics supporting the NYISO staff's recommendation of Project T027 for Segment A and Project T029 for Segment B and a discussion of the assumptions underlying the NYISO's analysis.

Qualitative and Quantitative Evaluation Metrics

The NYISO presented several quantitative and qualitative metrics of the impacts and costs of each project and outlined how these metrics were ultimately considered in its recommended selection of Projects T027 and T029. While estimates of cost and economic value are relatively

5 These criteria may be found in: PSC Case No. 14-E-0454, *In the Matter of New York Independent System Operator, Inc.'s Proposed Public Policy Transmission Needs for Consideration, Order Finding Transmission Needs Driven by Public Policy Requirements* (December 17, 2015), Appendix B.

straight-forward, it can be difficult to evaluate metrics that are either qualitative or quantified in non-dollar terms. So, the following summarizes how we consider the diverse set of metrics and modeling results calculated by the NYISO or derived from its evaluation:

- Environmental Benefits – These include the value of CO_2 emissions abatement across New York, New England, Ontario, and PJM that would result from a proposed project.
- Production Cost Savings – These include reductions in fuel costs, variable O&M costs, and any other generator production costs (excluding emissions allowance costs) across the same region.[6]
- Generation Investment Cost Savings – These also include the reduced cost of investment in generation necessary to satisfy the minimum resource adequacy planning standard.
- Reliability Benefits – A portion of the reliability benefits are embedded in the economic benefits because transmission reduces the cost of satisfying the system's real-time reliability needs and long-term planning needs. However, the value of more reliable service (than the minimum resource adequacy standard) is best measured by how the projects affect the loss of load expectation ("LOLE"). We quantify this based on the compensation that a generator would receive in the capacity market for providing comparable LOLE benefits.
- Avoided Costs from Replacement of Aging Equipment – When new transmission equipment replaces existing equipment, there are two types of potential cost savings. First, there is an O&M cost reduction that helps offset the O&M costs of the new equipment. Second, if the existing equipment is at the end of its useful life and needs to be replaced or otherwise refurbished, it would require capital expenditures that are made unnecessary by the new equipment.
- Reduced Need for Generation in Downstate Areas – The primary rationale for the Public Policy Requirement (not including standard wholesale market objectives) was that it would reduce the need for generation in downstate areas. We estimate the amounts of installed capacity and electricity production in downstate areas (i.e., in Zones H, I, J, and K) that would be displaced by the new transmission projects.

We include the first five categories above in a single benefit-cost ratio, which provides the best overall measure of the value of a project relative to costs. The Reduced Need for Generation in Downstate Areas is reported separately (although it also accounts for a portion of the cost savings and the environmental and reliability benefits). Section II.C provides additional details about these quantitative metrics.

6 Section II.C.1 discusses differences between this quantity and production cost savings reported by the NYISO.

The NYISO also identified several qualitative benefits categories such as Operability, which it defines as: the extent that a given project affects flexibility in operating the system, such as dispatch of generation, access to operating reserves, access to ancillary services, or the ability to remove transmission for maintenance. Operability and some of the NYISO's other qualitative metrics are partly reflected in our estimated cost savings and reliability benefits metrics. Section II.C further discusses the use of these metrics.

Summary of Assessment of Cost and Benefits for Recommended Projects

Our review focuses on two scenarios that were evaluated by the NYISO:

- Baseline Case, which used assumptions from the 2017 CARIS study with several updates, and
- CES+Retirement Scenario, which assumed that New York achieves the Clean Energy Standard ("CES") by constructing 16.2 GW of new renewable generating capacity and retiring the Indian Point nuclear plant, all coal-fired generation, and 3.5 GW of older peaking generation in downstate areas.

The Baseline Case reflects conditions that might be expected without significant public policy intervention by New York State, while the CES+Retirement Scenario reflects conditions if certain key policy initiatives are carried out. However, the specific policy assumptions used in the CES+Retirement Scenario were not laid out in the NYPSC Order directing the NYISO to evaluate solutions to its Public Policy Requirement. Hence, the NYISO had to exercise its judgement in developing the assumptions and constructing the CES+Retirement Scenario.

The following summarizes our assessment of the impact of the recommended projects:

Overall Benefit-Cost Ratio. Based on the combined Environmental, Economic, and Reliability benefits, we find an overall Benefit-Cost Ratio of 0.83 in the Baseline Case and 1.77 in the CES+Retirement Scenario over a 45-year period.

- Thus, the recommended projects are unlikely to be efficient or cost-effective without significant changes in the resource mix from key public policy initiatives. Since the PSC Order did not identify the specific public policy objectives that the AC Transmission solutions were designed to satisfy, the NYISO had to make assumptions. While some assumptions can be traced back to an existing New York State law or regulation (e.g., the Clean Energy Standard), others cannot (e.g., retiring 3.5 GW of peakers in downstate areas).
- There is considerable uncertainty regarding the benefits from the recommended transmission projects because the benefits would depend on where renewable resources are placed to satisfy the CES. The NYISO assumed that 14 GW of land-based wind and utility-scale solar additions would be made outside Southeast New York ("SENY") and

that just 226 MW of offshore wind would be placed in downstate areas. However, after the NYISO's study was underway, NYSERDA announced plans to solicit 2.4 GW of offshore wind in downstate areas by 2030, including 800 MW in 2018 and 2019. Increased offshore wind in downstate areas would reduce the need for renewables outside SENY to satisfy the CES. Hence, the recent shift in the planned placement of renewable generation (from upstream to downstream of the projects) would make the recommended projects less beneficial.

- Ultimately, it is difficult to know how sensitive the results are to particular assumptions since the NYISO did not run other CES-related scenarios. However, the recommended projects will likely be economic if large quantities of new renewable generation are sited west of the Central-East interface and the upstate nuclear units remain in service.

Reducing Need for Generation in Downstate Areas. The projects increase the transfer capability substantially over the UPNY/SENY interface, but will not result in large increases in power flows into SENY because of forecasted bottlenecks mostly downstream of these interfaces that are discussed below. The projects will:

- Increase transfer capability across the UPNY/SENY interface by 1,326 MW.
- Increase flows across UPNY/SENY by an average of just 170 MW in the Baseline Case and 210 MW in the CES+Retirement Scenario.
- Reduce the need for conventional generation in downstate areas by an average of just 145 MW in the Baseline Case. This amount rises to 300 MW in the CES+Retirement Scenario, but this is just 15 percent of the 2.0 GW of new conventional resources that will be needed by 2042 in the CES+Retirement Scenario.
- Hence, the recommended projects would offset just 4 percent of MWhs of generation and 2 percent of the installed generating capacity needs in downstate areas in the CES+Retirement Scenario.
- The benefits are limited in part by the prescriptive nature of the PPTN Order regarding the potential transmission solutions. A less prescriptive order would likely allow for transmission solutions that would be more effective at potentially lower costs.

Transmission Congestion Patterns – The recommended transmission projects would relieve key transmission bottlenecks from central New York to the Hudson Valley, but other less severe bottlenecks would remain.

- The recommended projects significantly increase capability across the Central East interface (from Zone E to F) and the UPNY/SENY interface (from Zones E&F to G), which would significantly reduce transmission congestion across both interfaces.

- However, other less significant bottlenecks are forecasted to remain between Segments A and B (in Zone F) and on flows into New York City and Long Island from upstate (from Zone I to J and I to K).
- Ultimately, the recommended projects are configured in a way that satisfies a relatively small share of the energy and capacity needs that would result from retirements in downstate areas in the CES+Retirement Scenario (i.e., Zones H, J, & K).

Observations Regarding the Public Policy Transmission Need Defined by the PSC

The New York PSC ordered a Public Policy Transmission Need to build, upgrade, or retire specific transmission elements in four areas of the state. The PPTN was extremely prescriptive about the specific transmission solutions that the NYISO should solicit, so there was relatively little variation across the proposed solutions. If the PPTN had focused on the underlying public policy objectives rather than specifying the facilities to be upgraded, transmission developers would likely have been able to propose more efficient and cost-effective projects.

The NYISO's study indicates that while Segments A and B significantly reduce transmission congestion, transmission bottlenecks south of Segment B still remain, suggesting that additional transmission may be needed for a "Segment C" from the Hudson Valley to New York City and/or Long Island to facilitate much larger flows into downstate areas. In its rationale for defining a PPTN involving specific upgrades in four distinct areas, the PSC order acknowledged the interdependence of new transmission projects in meeting its objectives:

> The [PPTN] is for the entire portfolio…Segment A depends upon Segment B being in place, so Segment A would not be constructed without certainty that Segment B would be constructed. Segment B depends upon certain specified add-ons being in place, so Segment B would not be constructed without certainty that the specified add-ons would be constructed.[7]

If a "Segment C" is needed in order to capture the full benefits of the projects in this study, it would be more cost-effective to perform a single comprehensive assessment that takes into account the interdependencies of the different segments.

Comments on Modeling Assumptions and Aspects of the PPTP Process

This report also discusses aspects of the public policy transmission project ("PPTP") evaluation process that may be important to enhance in future PPTP processes. Ultimately, if these factors were addressed, it would affect the overall conclusions regarding the cost-effectiveness of the recommended projects. Section II.D discusses these factors in greater detail.

7 See PPTN Order, Appendix A.

Conclusion

The proposed projects fulfill the Public Policy Requirement that was defined by the PSC. However, the Public Policy Requirement defined a specific set of proposed projects rather than the underlying public policy objectives. The recommended projects increase transfers from upstate to downstate, but only by a modest amount. Even in the CES+Retirement Scenario, the recommended projects offset only 4 percent of generation and 2 of installed capacity requirements in downstate areas.

We assess whether the recommended projects would adversely affect the market by undermining wholesale market prices and/or crowding-out more efficient investment.

- Under the Baseline Case (which does not consider major renewable generation additions to achieve public policy objectives), the recommended projects would not satisfy a basic cost-benefit test, raising concerns that the recommended projects would adversely affect the wholesale electricity markets.
- Under the CES+Retirement Scenario, the recommended projects clearly satisfy a basic cost-benefit test because of the increased value of transfers to downstate areas from low-emitting, low-variable cost resources in upstate New York. However, the benefits from the projects would be sensitive to the locations of particular resources that will be used to satisfy the Clean Energy Standard. For instance, if the PSC relies more on offshore wind rather than renewable generation upstate, it would reduce the benefits from the recommended transmission projects.

Ultimately, the economic benefits of the recommended projects are limited by prescriptive requirements in the PPTN order and the fact that the projects terminate in the Hudson Valley (Zone G). In future public policy transmission processes, it would be beneficial to define requirements based on the underlying public policy objectives. This would allow developers the flexibility to propose projects that would produce the largest benefits at the lowest costs.

II. EVALUATION THE MARKET EFFECTS OF PUBLIC POLICY PROJECTS

A. Principles for the Evaluation of Market Effects

The purpose of the PPTP process is to identify transmission investments that would provide significant public policy and wholesale market benefits, but which would not move forward based on the other planning processes and/or market incentives for transmission. However, it is critical for the PPTP process to function in a manner that supports the NYISO's competitive wholesale markets. This section discusses the principles we use for evaluating the qualitative and quantitative benefit metrics against the estimated costs of proposed projects, and ensuring that the PPTP process does not undermine the wholesale market.

Transmission upgrades can provide many wholesale market and public policy benefits to the system. Additional transmission capability can:

- Increase the utilization of low-cost generation, which lowers production costs; and
- Satisfy public policy objectives, such as reducing environmental emissions by facilitating increased development and dispatch of lower-emitting resources.

Therefore, to assess the value of a proposed transmission project, it is important to fully quantify these benefits to determine whether the project is economic.[8] The NYISO's economic transmission planning process (CARIS) does not consider several key wholesale market benefits (not to mention public policy benefits). This is partly why no transmission project proposal has ever been deemed to be cost-effective under CARIS. The PPTP process allows the NYISO to consider additional benefits for a more complete assessment of whether a proposed project is truly economic.

In Section II.C of this report, we discuss a framework for quantifying the different categories of wholesale market and public policy benefits. This framework incorporates cost savings, reliability benefits, and environmental benefits into a single metric that assists in evaluating the impact on wholesale electricity markets from the proposed projects. Section II.C.2 provides the results of this benefit-cost metric for the recommended projects.

Although reducing wholesale market congestion will always produce benefits, these benefits must exceed the costs of the transmission project to conclude that the project is economic. Uneconomic transmission investment can inefficiently reduce wholesale prices, crowd-out efficient private investment, and ultimately increase the cost of satisfying public policy objectives. Therefore, our criteria for determining that a public policy transmission project is

8 We recognize that some of the public policy benefits are subjective and may not be quantified easily.

economic for purposes of this evaluation is: *the priced and unpriced benefits of the project exceeds its costs.*

Projects that do not satisfy this general principle will harm the markets and ultimately raise costs to consumers in New York. Therefore, we evaluate the costs and benefits of each of the proposed projects, which includes a review of the assumptions used to estimate the projects' benefits. We then apply this principle to determine whether the project recommended for selection by the NYISO would adversely affect the NYISO's wholesale electricity markets.

As a general matter, projects are more likely to be economic if the PPTN is defined in a manner that is focused on the ultimate public policy objective, and are not unnecessarily prescriptive. To the extent that the PPTN requires specific characteristics for the transmission solutions, it will likely foreclose opportunities for the most efficient proposals to come forward in the PPTP process. For example, rather than specifying the amounts and locations of additional transmission desired to achieve a public policy objective, it would be better for the PPTN to specify the ultimate objective as well as any key project constraints driven by siting issues and other considerations. This would allow developers to propose more creative and cost-effective solutions. Section II.B discusses the Public Policy Requirement and the related PPTN that were defined by the PSC and that determined the scope of this PPTP study.

Finally, although there is substantial overlap, these principles and metrics for evaluating market effects are not the only factors considered by NYISO in selecting a recommended project. The NYISO considers other qualitative factors that are not fully reflected in the benefit-cost evaluation. These are discussed in Section II.C.3.

B. Comments on the Public Policy Transmission Need Defined by the PSC

In accordance with FERC Order 1000, the NYISO tariff allows for recovery of the costs of transmission projects that are built to achieve public policy requirements from New York State laws or regulations. In December 2015, the NYPSC issued an order finding a Public Policy Requirement to build "…a portfolio of 345 kV transmission projects to reconfigure and upgrade transmission facilities [involving ten specific substations in Zones E, F, and G.]" The order went on to define the PPTN, which provided additional specifics about the upgrades that were directed at the ten substations.[9]

While the Public Policy Requirement identified a long list of standard wholesale market objectives, such as cost savings and reliability, it also identified several objectives that are outside the ordinary scope of the wholesale market including: serving more load in downstate areas from efficient and/or renewable resources upstate, promoting job growth, increasing tax receipts, and reducing generation with harmful environmental and health effects. In Section II.C

[9] The full texts of the Public Policy Requirement and the PPTN are provided in Section III.

of this report, we provide a benefit-cost metric that incorporates the benefits related to standard wholesale market objectives as well as environmental benefits from reducing CO_2 emissions. While this report does not evaluate whether the recommended projects provide net benefits related to job growth and increased tax receipts, we summarize the extent to which the new projects satisfy the objective of serving downstate areas with resources from upstate resources, which provides some indication of any additional environmental and health benefits.

The Public Policy Requirement and the PPTN provided limited details about the specific policy objectives that would be served by the new transmission projects, but they were very prescriptive about the particular transmission solutions that were to be solicited by the NYISO. This had several key implications for the NYISO's PPTP study.

First, since the PPTN lacked specifics about the location, characteristics, and quantity of renewable generation in upstate areas that was to be made deliverable to downstate areas, the NYISO had to make speculative assumptions. The NYISO's CES+Retirement Scenario assumed 14 GW of new land-based wind and solar in Zones A to F, just 226 MW of offshore wind, and no energy storage.[10] These assumptions were based on the NYS Department of Public Service staff whitepaper on the Clean Energy Standard published in January 2016.[11] However, after the NYISO's study was underway, the state announced plans to satisfy its policy objectives with 2.4 GW of offshore wind and 1.5 GW energy storage in downstate areas, which would require fewer renewable resources in upstate areas.[12] Hence, it is unclear whether the PPTP study included a realistic CES policy scenario.

Second, the PPTN also lacked specifics about the policy-related retirements that should be facilitated by the new transmission. The NYISO's CES+Retirement Scenario assumed 5.7 GW of retirements in Zones H, J, and K, including the Indian Point nuclear plant and 3.5 GW of older peaking units.[13] There is speculation that these older peaking units without back-end emissions controls will be phased-out by a forthcoming DEC rule. However, this information was not available to developers when they submitted proposed transmission solutions. Consequently, the proposed transmission solutions facilitate a relatively modest amount of increased flows from upstate to downstate areas partly because of bottlenecks downstream of the proposed projects. Ultimately, developers could have proposed more efficient and cost-effective projects if the PPTN included specifics about key policy-related retirements.

10 See Table 3-4 of the AC Transmission Public Policy Transmission Planning Report.

11 See PSC Case No. 15-E-0302, staff whitepaper filed January 25, 2016.

12 For example, see https://www.greentechmedia.com/articles/read/new-york-throws-political-weight-behind-offshore-wind-and-energy-storage#gs.f8fOSZc

13 See page 48 of the AC Transmission Public Policy Transmission Planning Report.

Third, the Public Policy Requirement and the PPTN were unnecessarily specific about the particular transmission upgrades that would satisfy the underlying public policy objective. It is likely that this constrained the creativity of transmission developers in crafting proposals that would be most efficient and cost-effective.

C. Framework for Integrating Qualitative and Quantitative Metrics

The NYISO presented several quantitative and qualitative metrics of the impacts and costs of each project and outlined how these metrics were ultimately considered in its recommended selection of Projects T027 and T029. While estimates of cost and economic value are relatively straight-forward to interpret, it can be difficult to evaluate metrics that are either qualitative or quantified in non-dollar terms. This section discusses: (a) our approach to quantifying the economic, environmental, and reliability benefits which were the basis for the PPTN; and (b) our comments on other metrics that the NYISO uses to assess each project.

1. Cost Savings and Environmental and Reliability Benefits

The NYISO employed a diverse set of metrics for satisfying the PPTN, which can be used to derive the economic, environmental, and reliability benefits that would come from the recommended transmission projects.

Environmental benefits – A potential environmental benefit from proposed transmission projects is that they would allow zero-emission and relatively low carbon-intensity generation in upstate areas to offset the need for high carbon-intensity generation in downstate areas. However, new transmission would also affect CO_2 emissions over a wider region. The NYISO estimated the value of CO_2 emissions reductions using projected CO_2 allowance prices in Ontario, New York, New England, and PJM. These environmental benefits are reflected in the NYISO's GE MAPS production cost savings only to the extent that the simulations treated CO_2 allowance prices as a cost of generation.[14] Our benefit-cost metric includes the environmental benefits of CO_2 emissions reductions regardless of whether they are priced under a cap-and-trade program.

Production Cost Savings – A key economic benefit from the proposed transmission projects is that they allow increased generation from sources with low variable costs, which displaces generation from higher-cost sources. This production cost savings is measured using GE MAPS

14 The NYISO's Baseline Case assumed a federal CO_2 allowance program would be implemented in the fifth year of the study (i.e., 2027), so these benefits are not quantified in the production cost savings from the GE MAPS model from 2023 to 2026. However, in CES+Retirement Scenario, the NYISO assumed no federal CO_2 emission pricing program for the entire study period.

software.[15] This category does not include reductions in CO_2 allowance costs because those are categorized as environmental benefits.

We calculate the economic and environmental benefits of the recommended projects based on GE MAPS simulations performed by the NYISO. The following examples illustrate how we calculated the economic and environmental benefits from the GE MAPS simulations:

- Example 1 – A NY generator with fuel and variable O&M costs equal to $2/MWh and no emissions increases output by 1 MW, while a NY generator with fuel and variable O&M costs equal to $20/MWh and emissions costs of $8/MWh decreases output by 1 MW.
  - Environmental Benefit = $8 = $8 reduction of allowance costs minus $0 increase
  - Economic Benefit = $18 = $20 reduction of fuel/VOM costs minus $2 increase
  - GE MAPS Production Cost Savings = $26 = $28 reduction of generator costs minus $2 increase = Environmental Benefit + Economic Benefit
- Example 2 – A NY generator with fuel and variable O&M costs equal to $2/MWh and no emissions increases output by 1 MW, while a PJM generator with fuel and variable O&M costs equal to $20/MWh and emissions costs of $8/MWh decreases output by 1 MW.
  - Environmental Benefit = $8 = $8 reduction of allowance costs minus $0 increase
  - Economic Benefit = $18 = $20 reduction of fuel/VOM costs minus $2 increase
  - GE MAPS Production Cost Savings = $18 = $20 reduction of import costs minus $2 increase < Environmental Benefit + Economic Benefit

While our environmental and economic benefits are the same for Example 1 and Example 2, the GE MAPS Production Cost Savings would not be the same for Example 2. This is because if there is no CO_2 pricing regime in the neighboring area (which was assumed to be the case for most of PJM in the CES+Retirement Scenario), the production costs savings would exclude the value of emission reductions in such areas.

Lastly, we make three adjustments to the production cost savings drawn from the GE MAPS simulations. The first adjustment is designed to account for transmission outages and unexpected events that affect production costs in market operations (see Section II.D.1). The second adjustment is designed to account for the NYISO's assumption that new entry of generation will not occur until necessary to prevent the LOLE from rising above 0.1 days per year, while the capacity market is designed to induce new entry when there is still some surplus (see Section II.D.2). Third, we include production cost savings in years 21 to 45 of the project life, estimating them to be equal to the average annual production cost savings in years 1 to 20.

15 Note, NYCA Production Costs measure changes in net import charges to NYCA, but this may not be equal to the change in production costs of generators on the other side of the border. Nonetheless, we believe that the changes in net import charges are a reasonable proxy for changes in production costs in neighboring areas.

Generation Investment Cost Savings – An important economic benefit from the proposed transmission projects is that they would reduce the need to build and/or maintain installed capacity to satisfy minimum planning criteria for resource adequacy and inter-zonal transmission security, particularly capacity in downstate areas where investment costs are generally higher.

We estimate the investment cost savings from the recommended projects based on how they would affect the Compensatory MWs necessary to satisfy the resource adequacy standard (i.e., 0.1 LOLE). The following example illustrates how we calculated this type of economic benefit:

- Suppose that in the base case, 400 MW of Compensatory MWs would be needed in Zone J to maintain LOLE below 0.1 in particular year, while in the project case, upstate capacity would be more deliverable to downstate loads, so that the LOLE could be maintained below 0.1 with Compensatory MWs of 300 MW in Zone C and 50 MW in Zone J.[16]
    - Investment Cost Savings in Zone J in one year = $62 million = (400 MW – 50 MW) × Net CONE of $177/kW-year
    - Investment Cost Increase in Zone C in one year = $30 million = 300 MW × Net CONE of $100/kW-year
    - Net Investment Cost Savings in one year = $32 million = Investment Cost Savings in Zone J minus Investment Cost Increase in Zone C[17]
- The net present value of the Net Investment Cost Savings is calculated over an assumed 45-year project life cycle, using the net investment cost savings from the last year of the evaluation period to estimate savings in years 21 to 45.[18]

Reliability benefits – This metric captures the market value of more reliable service (than the minimum resource adequacy standard requires) as additional reliability is valued in the installed

16 The Compensatory MWs are provided in Table 3-3 of the AC Transmission Public Policy Transmission Planning Report.

17 For the purposes of calculating the investment cost savings, we exclude the property taxes from the net cost of new entry. This is because we also excluded property taxes from the lifecycle costs of the recommended transmission projects as well as the aging transmission facilities that would be retired because of the new transmission. In general, increased property tax receipts are not a net benefit from a societal point of view. After removing the property contribution, we used Net CONE estimates of $94/kW-year for Zone C, $139/kW-year for Zone H, $168/kW-year for Zone J, and $115/kW-year for Zone K.

18 This metric is similar to the NYISO's ICAP Savings metric, which is discussed in Section 3.3.8 of the AC Transmission Public Policy Transmission Planning Report. However, the NYISO's ICAP Savings metric is generally higher because it is based on the assumption that the system is at the minimum resource adequacy requirement of 0.1 LOLE in both the base case and the project case in every year of the evaluation (regardless of the LOLE in the actual base case and project case for the year). Consequently, the NYISO's ICAP Savings over-estimate the amount of generating capacity investment costs that would be reduced by the proposed projects.

capacity market. These benefits are best measured by how the projects affect the loss of load expectation ("LOLE"). We quantify this based on the compensation that a generator would receive in the capacity market for providing comparable LOLE benefits.[19]

We estimate the reliability benefits from the recommended projects to the extent that they improve the NYCA LOLE in each year of the study. These value of improved LOLE is consistent with the compensation to generation resources in the capacity market. Based on our evaluation of the capacity demand curves and locational capacity requirements for the 2018/19 Capability Year, we estimate that generating resources are paid $2.9 million per 0.001 change in the LOLE per year.[20, 21] The following example illustrates how we calculated these benefits:

- Suppose that in the base case for a particular year, the LOLE is 0.08 days per year, while in the project case for the same year, the LOLE is 0.06 days per year.
    - Reliability Benefit in one year = $58 million = (0.08 – 0.06 days per year change in the LOLE) × $2.9 million per 0.001 days per year change in LOLE.
- The net present value of the retirement benefits is calculated over an assumed 45-year project life cycle, using the benefits from the last year of the evaluation period to estimate savings in years 21 to 45.[22]

Avoided Costs from Replacement of Aging Equipment – When new transmission equipment replaces existing equipment, there are two types of potential cost savings. First, there is an O&M cost reduction that helps offset the O&M costs of the new equipment. Second, if the existing equipment is at the end of its useful life and needs to be replaced or otherwise refurbished, it would require capital expenditures that would be rendered unnecessary by the new

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19 Transmission can improve reliability in a variety of ways, including improving transmission security and the robustness of the system in general, as well as by improving resource adequacy by making resources more deliverable and able to be deployed when system contingencies occur. A substantial share of these reliability benefits translate into cost reductions, which are reflected in our Economic Benefit metrics that reflect production cost savings and generation investment cost savings.

20 See *2017 State of the Market Report*, Section VII.D.

21 As noted in footnote 17~~21~~, we exclude the effects of property taxes from other elements of the benefit-cost ratio because increased property tax receipts are not a net benefit from a societal point of view. Accordingly, we exclude property taxes from the lifecycle costs of the recommended transmission projects, new generating capacity, and aging transmission facilities that would be retired because of the new transmission. Since the estimated capacity payments to generation of $2.9 million per 0.001 change in the LOLE per year are derived from the net cost of new entry, we removed the contribution of property taxes from the estimated value of reliability benefits. After excluding property taxes, the estimated value is $2.7 million per 0.001 change in the LOLE per year.

22 LOLE information was only available for 2025, 2030, 2035, and 2040, so we estimated the LOLE values in the other years by interpolation, taking into account the Compensatory MWs and approximations of the marginal impact of capacity additions.

equipment. For the recommended projects, the NYISO and its consultant SECo identified specific transmission facilities that would be decommissioned as a result of the recommended projects.[23]

For all facilities that were removed from service, we estimated the reduction in O&M costs, assuming an annual O&M cost of 2.85 percent of the overnight cost of installing similar equipment, and calculating the net present value over an assumed 45-year project life cycle.[24] We used the same method to estimate the O&M costs of the new equipment.

For existing equipment that would need to be replaced or refurbished in the foreseeable future, we estimated the net present value of avoided capital expenditures. We assume that if the recommended projects were not installed, it would be necessary to: (a) fully replace all but 12.6 miles of each of the two Porter-to-Rotterdam 230kV lines, (b) replace the transmission lines (but not the transmission towers) for 12.6 miles of the same facilities; and (c) fully replace 87 miles of 115kV double-circuit 115kV lines between the Knickerbocker and Pleasant Valley substations.

The net present value of capital expenditures to rebuild or refurbish existing equipment depends on when the expenditures would have been incurred if the new transmission was not built, so there is a great deal of uncertainty about when that would be. For example, the STARS Phase II Study Report was published in April 2012, indicating that both Porter to Rotterdam lines should be replaced within ten years.[25] However, in an October 2012 report to the PSC, National Grid stated that it was planning to perform a condition assessment of these lines before determining

23 These include: two 230kV lines from Edic (near Porter) to Rotterdam, one double-circuit 115kV line from Knickerbocker to Churchtown, two double-circuit 115kV lines from Knickerbocker to Pleasant Valley, the Churchtown 115kV substation, some equipment at the Rock Tavern substation, a double-circuit 69kV line from Shoemaker to Sugarloaf, 6.3-mile section of the Marcy to New Scotland 345kV line, a 13.4-mile section of the Princetown to New Scotland 115kV line, and the Rotterdam 230kV substation. See Section III for decommissioning required by the PPTN, and see *AC Transmission New York Public Policy Transmission Need, Technical Review Report*, Revision 6, by SECo ("SECo Report"), Section 4.10, for a list of facilities that would be decommissioned by individual projects.

24 The DPS filed materials using 2.85 percent of overnight costs as an estimate for O&M in the AC Transmission PPTN proceeding. See slides 46 and 112 of the Brattle Group's September 15th 2015 presentation on *Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades.*

We estimated the overnight cost of similar equipment using the following assumptions: $4.0 million per mile for a double-circuit 345kV line, $3.4 million per mile for a 345kV line, $3.2 million per mile for a 230kV line, $2.5 million per mile for a double-circuit 115kV line, $2.2 million per mile for a 115kV line. For projects that would mount new lines on existing towers, we assumed a 0.4 cost multiplier. For the equipment to be replaced for the local upgrade facilities in Segment B, the decommissioning of two substations, and circuit breakers, we assumed an overnight cost of similar equipment at $100 million.

25 See pages 33-35.

the appropriate scope and schedule for refurbishment.[26] Ultimately, SECo and the proposers in the AC Transmission PPTP process found that 12.6 miles of existing towers for each circuit were in good condition and did not warrant replacing.[27] To account for some uncertainty in our benefit-cost estimate, we assumed that the Porter-to-Rotterdam equipment would have been replaced in 2025 and that the Knickerbocker to Pleasant Valley equipment would have been replaced in 2035.[28]

Reduced Need for Generation in Downstate Areas – The primary rationale for the Public Policy Requirement (not including standard wholesale market objectives) was that it would reduce the need for generation in downstate areas. We estimate the average reduction in generation in downstate areas based on the average increase in flows across the UPNY/SENY interface between the base case and the project case.[29] We also estimate the average reduction in the amount of generating capacity in downstate areas based on the difference in Compensatory MWs between the base case and the project case.[30]

2. Evaluation of the Economics of the Proposed Public Policy Transmission Projects

We have reviewed modeling results for the recommended public policy transmission projects, T027 and T029. Using these results and the project costs presented in the NYISO report, we calculated the economic, environmental, and reliability benefits for these projects and compared these benefits to the project costs. We include the project costs for the local upgrade portions of Segment B, since these are an integral component of the segment. Likewise, we include estimated O&M costs for the new recommended projects. We assume a net present value of $1.77 billion for the overall cost of the projects over a 45-year period, including a $1.08 billion overnight cost for the recommended projects, $113 million for the local upgrades, $109 million for interest during construction and other financing costs, and $465 million for the net present value of 45 years of O&M. Figure 1 summarizes the cost savings and other benefits from the

26 See *Report on the Condition of Physical Elements of Transmission and Distribution Systems*, by National Grid, NY PSC Case No 06-M-0878, dated October 1, 2012, pages 12-14.

27 See SECo Report, Section 4.10.1.

28 In its work to support the DPS in the AC Transmission proceeding, Brattle Group assumed Porter to Rotterdam equipment would be replaced in 2020, but Brattle ran a sensitivity assuming the lines would not be replaced until 2030, acknowledging the uncertainty around such projections. Likewise, Brattle assumed the Knickerbocker to Pleasant Valley equipment would be replaced in 2030, but a sensitivity assumed this equipment would not be replaced until 2040. See Brattle Group's October 8, 2015 presentation *Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades*, slides 34 & 43.

29 See Section 3.3.6 of the AC Transmission Public Policy Transmission Planning Report.

30 The Compensatory MWs are provided in Table 3-3 of the AC Transmission Public Policy Transmission Planning Report for 2042. The NYISO provided us with data for each year of the evaluation.

recommended projects in the Baseline Case and the CES+Retirement Scenario relative to the project costs.

Figure 1: Results for T027 and T029 Combination

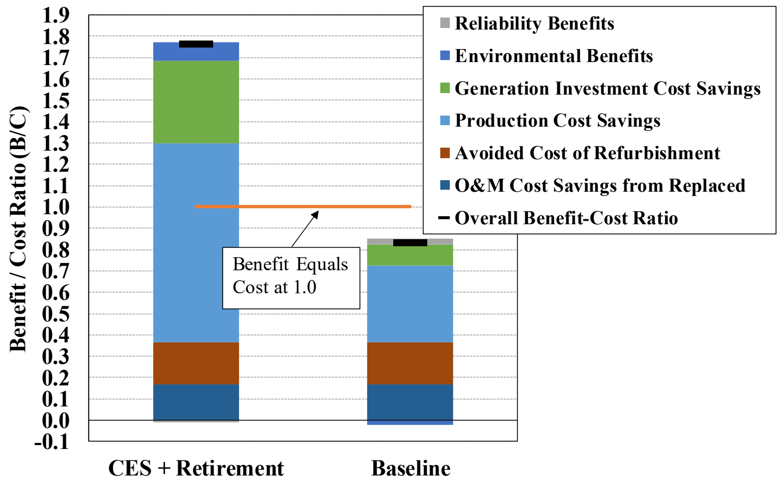

Figure 1 shows that the aggregate cost savings and other benefits we calculate are lower than the projects' costs in the Baseline Case with a B/C ratio of 0.83. The overall cost savings and other benefits are substantially higher than the projects' costs in the CES+Retirement Scenario, which has a B/C ratio of 1.77.

Installation of the recommended projects would allow for the decommissioning of substantial quantities of existing equipment. Since we consider the O&M cost of the new equipment in the cost portion of the B/C ratio, we consider the reduction in O&M cost from equipment that is decommissioned as a benefit over the 45-year period. We also consider the avoided costs of not having to replace or refurbish older equipment, including 225 miles of existing high voltage lines. Together, these two categories account for a large component of the overall benefits with a net present value of $649 million.

In both scenarios, a key benefit comes from lower production costs as the transmission projects would allow low-cost generation in western New York to displace higher-cost resources in eastern New York and New England. The CES+Retirement Scenario exhibits larger production costs savings ($1.64 billion) than the Baseline Case ($631 million) because the CES+Retirement Scenario includes much larger quantities of renewable generation outside SENY than does the Baseline Case.

Investment cost savings are substantial in both scenarios as the transmission projects would reduce Compensatory MWs by 300 MW in Zone J in each year of the CES+Retirement Scenario (resulting in savings of $687 million) and by up to 400 MW after 2033 in the Baseline Case (resulting in savings of $178 million).

Reliability benefits are very close to zero in the CES+Retirement Scenario. This is because the proposed transmission projects reduce the need for generation in Zone J, but the overall LOLE is similar between the base case and project case because the project case assumes less generation investment. On the other hand, reliability benefits are higher in the Baseline Case because the recommended transmission projects lead to an improved LOLE from 2023 to 2033 (instead of reducing the need for investment in generating capacity).

These results indicate that the recommended projects would provide only modest environmental benefits from CO_2 emission reductions in the CES+Retirement Scenario and small negative environmental impacts in the Baseline Case. This pattern reflects that while the transmission projects would allow more low-emission resources in western New York to displace fossil-fueled generation in eastern New York and New England, this also leads to additional net imports from PJM, which has relatively high-emission intensity generation.

3. Other Quantitative Measures of Impact

The recommended projects increase the transfer capability substantially (1,326 MW) over the UPNY/SENY interface,[31] but will not result in large increases in power flows into SENY because of forecasted bottlenecks mostly downstream of these interfaces that are discussed below. The projects would increase flows across UPNY/SENY by an estimated average of just 170 MW in the Baseline Case and 210 MW in the CES+Retirement Scenario. Furthermore, the projects would reduce the need for conventional generation in downstate areas by an average of just 145 MW in the Baseline Case. This amount rises to 300 MW in the CES+Retirement Scenario, but this is just 15 percent of the 2.0 GW of new conventional resources that will be needed by 2042 in the CES+Retirement Scenario.[32]

The recommended transmission projects would relieve key transmission bottlenecks from central New York to the Hudson Valley, but other less severe bottlenecks would remain. The recommended projects significantly increase capability across the Central East interface (from Zone E to F) and the UPNY/SENY interface (from Zones E&F to G), which would significantly reduce transmission congestion across both interfaces. However, other less significant bottlenecks are forecasted to remain between Segments A and B (in Zone F) and on flows into New York City and Long Island from upstate (from Zone I to J and I to K).

4. Qualitative Metrics

The NYISO identified several benefits categories that were qualitative in its evaluation, which included: “Performance,” “Operability,” and “Expandability.” The NYISO also identified project risks using qualitative designations. While these categories are inherently difficult to estimate, when interpreting the results, it is important to consider the extent to which these qualitative risks and benefits are reflected in the quantitative metrics.

Performance. Defined as how the proposed project may affect the utilization of the system. In the AC Transmission PPTP Report, this was based on the amount by which a project would increase flows from upstate to downstate over the Central East and UPNY/SENY interfaces.

31 See Table 4-3 of the AC Transmission Public Policy Transmission Planning Report.

32 The Compensatory MWs are provided in Table 3-3 of the AC Transmission Public Policy Transmission Planning Report for 2042.

The estimated economic and environmental benefits of this performance is largely reflected in the GE MAPS simulations, so the qualitative assessment of Performance is not an entirely distinct benefit.

Operability. The extent that a given project affects flexibility in operating the system, such as dispatch of generation, access to operating reserves, access to ancillary services, or the ability to remove transmission for maintenance. The NYISO 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. The NYISO identified as superior projects that would provide greater ability to remove transmission facilities for maintenance or higher transfers under a N-1-1 contingency criteria. This operational flexibility is important during significant transmission outages or other changes in system conditions that are not considered in the GE MAPS estimates.

Expandability. Considers the impact of the proposed solution on future construction and the extent to which any subsequent expansion of the system will continue to use a proposed transmission project. The potential benefits of future expansion are not reflected in the NYISO's quantitative metrics. Ultimately, it is difficult to forecast whether this expandability will be utilized in the future.

PSC Criterion on Aging Infrastructure. Project selection process also considered favorableness of the Public Policy Transmission Projects that result in upgrades to aging infrastructure, like retirement of existing substation, etc. The avoided cost of refurbishment to existing transmission facilities and reduced O&M costs from decommissioned facilities accounted for significant benefits in the AC Transmission Study. We discuss these benefits further in Section III.D.1.

Permitting and other risks to the project timeline. The permitting agency may require changes that increase the overnight or lifecycle costs, or it may not grant the use of certain rights of way. A project may take more time to develop than anticipated, which tends to increase project financing costs and reduces the net present value of benefits from the project. These risks were considered in the NYISO's estimated duration of development for each project.

D. Key Assumptions Used to Estimate Benefits and Costs

This section discusses key assumptions used in the NYISO's estimates of the costs and benefits of the proposed projects. We also discuss several factors that were not considered in the NYISO's estimates. Ultimately, we find that the overall effect of addressing these factors would likely be a modest increase in the overall benefit-cost ratios for the recommended projects.

These factors may become more important in a future PPTP process, so we recommend the NYISO consider addressing issues in future evaluations. Subsection 1 discusses the estimation of individual project costs. Subsection 2 addresses the NYISO's assumptions regarding retirements and new entry over the study period. Subsection 3 evaluates the assumptions used in the production cost simulation model.

1. Factors Affecting Costs of Proposed Projects

In accordance with its Tariff, the NYISO considered only the overnight capital costs of the proposed projects. The NYISO requested detailed project information from the developers, but it ultimately utilized an independent consultant to estimate the overnight costs of the proposed projects. While the NYISO's approach was reasonable in this evaluation, we recommend the following improvements in estimating project costs in future PPTP evaluations.

First, the NYISO's evaluation does not quantify non-capital costs such as O&M costs that would be incurred by proposed projects or aging infrastructure that is decommissioned, although these costs are significant. To illustrate, in the AC Transmission Proceeding, the Brattle Group estimated that the O&M costs for transmission projects typically add 39 percent to the net present value of the project's revenue requirement over a 45-year amortization period.[33] We included estimated O&M costs in our B/C ratio based on generic cost information, but we recommend that the NYISO estimate these costs as part of its evaluation in future PPTP evaluations.

Second, the NYISO's evaluation does not quantify the avoided cost of not having to refurbish aging infrastructure. In this study, these costs were quite significant, so we included estimates in our B/C ratio based on generic cost information, but we recommend that the NYISO estimate these savings as part of its evaluation in future PPTP evaluations.

Third, the NYISO in its evaluation did not utilize capital cost estimates that were submitted by the developers, and instead relied entirely on independent estimates provided by its consultant. Several developers have indicated that the NYISO's cost estimates are significantly different from their own estimates. For instance, one developer indicated that SECO's cost estimate for concrete poles was 100 percent higher than its own estimate.[34] If developers were able to make firm offers and take on the risk of cost overruns related to their proposed projects, it would be reasonable and beneficial to rely on the developers' cost estimates. Unfortunately, this is not allowed under the current tariff and rules so utilizing an independent third party to develop an

33 See slides 46 and 112 of the Brattle Group's September 15th 2015 presentation on *Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades.* The Brattle Group utilized a spreadsheet provided by the DPS to estimate the O&M costs in its analysis. The NYISO posted the DPS spreadsheet at http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Public_Policy_Documents/AC_Transmission_PPTN/DPS_AC_Transmission_PVRR_Model.xls

34 See May 14th 2018 comments of NextEra Energy on Draft AC Transmission Public Policy Transmission Planning Report.

unbiased cost estimate is reasonable. However, the fact that this option is unavailable to the developers precludes an efficient assignment of risk and realization of the full benefits of competition for the ratepayers. Hence, it would be beneficial to develop tariff provisions that would allow developers to take this risk by guaranteeing their costs.

2. Assumptions for Resource Mix

A number of evaluation metrics considered by the NYISO (including production cost savings, performance, reduction in CO_2 emissions) are significantly impacted by the assumptions regarding the mix of resources in NYCA and neighboring regions over the study period. As discussed earlier, for the Baseline Case, the NYISO utilized the 2017 CARIS Phase 1 database with a number of updates. For the CES+Retirement Scenario, the NYISO used the zonal resource mix defined by the New York State Department of Public Service (DPS) for the State Resource Planning study in identifying where intermittent renewables were likely to interconnect, and the NYISO used its judgment in identifying which generators would retire. While it is reasonable to rely on the models and methodologies that have been developed in the NYISO's well-established economic transmission planning process (i.e., CARIS), we identify several assumptions that might be enhanced in future PPTP processes.

First, in all scenarios, the NYISO assumed that new entry of conventional resources would occur such that the system meets the minimum resource adequacy standard in each year of the study period (i.e., that LOLE does not exceed one day in ten years). However, the NYISO's capacity market is designed to incentivize investment to maintain a small excess capacity margin, so the average LOLE would not be expected to exceed 0.7 days per ten years.[35] Consequently, the NYISO's assumption leads to an unrealistically low capacity margin from 2034 to 2042 in the Baseline Case and for all 20 years of the CES+Retirement Scenario. The low capacity margin leads to inflated production cost savings, investment cost savings, and reliability benefits from the new transmission, which tends to overstate the overall benefit-cost ratio of the projects. To account for this, we reduced the production cost savings by 10 percent in our B/C ratio, but we recommend that the NYISO modify this assumption in future evaluations to be more consistent with the NYISO market design.

Second, other than the addition of Compensatory MWs, the NYISO's scenarios did not systematically consider how new transmission lines would affect future entry and exit decisions by generators. Thus, we recommend that the NYISO incorporate a model for entry and exit decisions of renewable and fossil-fuel generators and energy storage resources upstream and downstream of the constraint in its future PPTP assessments.[36]

35 See page 55 of the *2016 State of the Market Report for the New York ISO Markets* by Potomac Economics.

36 It would be particularly important to incorporate an entry/ exit model when evaluating solutions to future PPTNs that are justified based on their ability to incent new (renewable or conventional) generation. This

Ultimately, if the NYISO implemented these two recommendations, it would make the estimated benefits less sensitive to the NYISO's assumptions regarding the status of any particular units. This is because the exclusion of particular generators would lead to new entry earlier in the study period, so the effects of these assumptions would be moderated significantly.

3. Production Cost Modeling Assumptions

Over the past decade, the NYISO has developed its production cost simulation models in the economic transmission planning process (i.e., CARIS), and the NYISO relied on these for evaluating proposed projects in this PPTP process. The NYISO utilized the GE-MAPS software to model the electrical system and estimate the production cost savings associated with the proposed projects. This was the primary model that was used to estimate economic and environmental benefits. While it is reasonable for the NYISO to rely primarily on the CARIS models, there are several modeling assumptions that could be modified in future PPTP processes to improve the accuracy of the estimated production cost savings.

First, the current GE-MAPS model does not include transmission outages and unforeseen factors such as load forecast error that exacerbate congestion during actual market operations and, as such, does not fully capture the value of new transmission lines that may help mitigate the impact of such factors. Transmission outages drive a large share of congestion in market operations, especially in areas with renewable generation. For example, we have found that most export-congestion from the North Zone is caused by transmission outages.[37] Moreover, in the AC Transmission Proceeding, the Brattle Group report developed several ways of estimating how transmission outages and other unforeseen factors would affect actual market outcomes relative to what the GE MAPS model would simulate, including one that would scale-up the production cost savings estimates by 40 percent.[38] We accounted for this issue in our B/C ratio by incorporating the 40 percent adder. Considering such factors would significantly increase the estimated benefits of new transmission, we recommend that future production cost simulations incorporate such factors.[39]

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would likely require the NYISO to evaluate each project relative to prices and other conditions in the project case, which would differ from the current paradigm that measures benefits using a comparison of a project case to a base case without the project.

37 For a discussion of the transmission outages and related congestion patterns, see Appendix Section III.B of the *2016 State of the Market Report for the New York ISO Markets.*

38 See slides 13-18 of the Brattle Group's October 8th 2015 presentation on *Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades.*

39 While the NYISO evaluated the reliability benefits from the proposed projects under various maintenance conditions as part of the Operability metric, this metric does not include a monetary valuation of the economic, environmental, and reliability impacts under maintenance conditions.

Second, estimated production cost savings are greatly affected by forecasted prices for natural gas and emissions allowances. The NYISO's sensitivity analysis revealed that both factors have a considerable impact on the estimated production cost savings. New investments in gas pipelines, LNG infrastructure, and generation assets in New York and neighboring regions are likely to affect congestion in the gas system, forecasted gas price levels, and gas price spreads in the region. Further, natural gas pipeline congestion has been the been the principal driver of congestion in the NYISO market since 2012. Hence, quality gas price forecasts and sensitivities are essential for evaluating the cost-effectiveness of new transmission investments.

III. TEXT OF THE PUBLIC POLICY REQUIREMENT AND TRANSMISSION NEED

In December 2015, the NYPSC issued an order finding the following Public Policy Requirement:

> it is the public policy of the State of New York and the Public Service Commission: 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, in the balanced and cost-effective manner that would be accomplished by the construction and operation of a portfolio of 345 kV transmission projects to reconfigure and upgrade transmission facilities from the Edic or Marcy substations to the New Scotland substation with a tie-in to the Rotterdam substation and from a new Knickerbocker substation to the Pleasant Valley substation, with upgrades at the Greenbush substation, including also upgrades to the Rock Tavern substation, and the construction of a new double circuit 138 kV line from the Shoemaker to Sugarloaf substations (and as more specifically described in Appendix A attached hereto), and that such policies constitute Public Policy Requirements driving transmission needs.
>
> The Commission also hereby finds that: the 2015 State Energy Plan, which contains adopted policies and long-range energy planning objectives and strategies, including fulfillment of the action items that constitute New York's Energy Highway Blueprint (implementation of a proposal to upgrade the transmission system being evaluated in the AC Transmission proceedings are one of the action items); Section 6-104(1) of the Energy Law which requires the State Energy Planning Board to adopt a State Energy Plan; and Section 6-104(5)(b) of the Energy Law which generally requires the Commission to make energy related actions or decisions that are reasonably consistent with the policies and long-range energy planning objectives and strategies contained in the State Energy Plan; together constitute Public Policy Requirements driving transmission needs.

Appendix A to the order stated that the Public Policy Requirement above leads to the following Public Policy Transmission Need:

<u>SEGMENT A</u>

> <u>Edic/Marcy to New Scotland; Princetown to Rotterdam</u> - 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; 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 doublecircuit 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; related switching or substation work at Greenbush, Knickerbocker, Churchtown and Pleasant Valley substations.

Upgrades to the Rock Tavern Substation - 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.

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.

Notes:

The need is for the entire portfolio, but the portfolio lends itself to segmentation such that transmission solutions should be solicited in a manner that allows applicants to propose solutions either by segment or on a combined portfolio basis, or in the alternative on both bases. Segment A depends upon Segment B being in place, so Segment A would not be constructed without certainty that Segment B would be constructed. Segment B depends upon certain specified add-ons being in place, so Segment B would not be constructed without certainty that the specified add-ons would be constructed.

IV. Conclusions

The NYPSC issued an order identifying a PPTN that would increase transmission flows from upstate areas to downstate areas. It directed the NYISO to consider solutions on four paths across the Central East and UPNY/SENY interfaces that would be expected to increase flows from low-cost and renewable generation upstate to loads in downstate areas. The NYISO, in accordance with the PPTP component of its comprehensive system planning process, evaluated 16 proposed projects that were proposed to address the PPTN. The NYISO published the Public Policy Transmission Planning report that summarizes the need, the proposed projects, V&S assessment, and the evaluation and selection of the most economic projects.

We reviewed the NYISO's report and evaluated the costs and benefits of the proposed projects in the context of assessing their effects on the NYISO markets. Based on this evaluation, we find that the NYISO's recommended projects (Projects T027 and T029) will be economic if the Clean Energy Standard is satisfied with high levels of intermittent renewable generation upstate. However, if state policies shift more investment to offshore wind and energy storage in downstate areas, the benefits from the recommended projects will be reduced. Ultimately, the benefits of the recommended transmission projects are heavily dependent on the placement of new renewable generation and the locations of retiring generation.

In general, we found the NYISO's methodologies for this assessment are reasonable. However, we identify several methodological enhancements for NYISO to consider in future public policy transmission evaluations. Recommended enhancements are summarized in the following table.

Table 1: Summary of Recommended Enhancements

Issue:	Section:
Consider incorporating additional priced and unpriced benefits of new transmission projects into a single B/C metric.	II.C
Estimate O&M costs of new and decommissioned facilities.	II.D.1
Estimate the cost savings from avoided refurbishment of older facilities.	II.D.1
Develop tariff provisions to allow developers to take risk of cost overruns.	II.D.1
Model entry and exit decisions for generators in a manner that is consistent with the expected competitive market outcomes.	II.D.2
Consider transmission outages and other unforeseen factors in estimating production cost savings.	II.D.3
Enhance quality of natural gas and emission allowance price forecasts.	II.D.3