NYISO MMU Evaluation of the Proposed Public Policy Transmission Projects in Western New York

POTOMAC ECONOMICS

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I. EXECUTIVE SUMMARY

Pursuant to FERC Order 1000, the NYISO developed tariff provisions to allow for recovery of the costs of transmission projects proposed to achieve public policy objectives through the NYISO's transmission rates. 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 that "significant environmental, economic, and reliability benefits could be achieved by relieving the transmission congestion identified in Western New York." The order directed the NYISO to consider solutions to "fully utilize Niagara and simultaneously maximize imports from Ontario, including at least 1,000 MW under emergency conditions" (known as the "Viability and Sufficiency Criteria"). [3]

Developers submitted 12 proposed projects, and the NYISO identified ten that would satisfy the Viability and Sufficiency Criteria. The NYISO performed a thorough analysis estimating the costs and benefits of these ten projects.

In particular, 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 operating requirements, and
- Other benefits from enhancing the bulk power system such as: expandability of new infrastructure, operability of transmission equipment, and performance of the project.

To evaluate the market effects of the public policy projects, we begin with the premise 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

1 See NYISO Open Access Transmission Tariff Section 31.4.11.

2 See NYISO Market Services Tariff Section 30.4.6.8.5.

3 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 Addressing Public Policy Requirements for Transmission Planning Purposes* (July 20, 2015), at p. 27.

market risks in the long-term. The determination of whether projects are economic must include factors that are not fully priced in the NYISO markets. Hence, 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), the MMU shall assess the 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 T014 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 Project T014. While estimates of cost and economic value are relatively 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 for satisfying the PPTN, which focused on the economic, environmental, and reliability benefits of reduced congestion:

- Environmental and Economic Benefits – We consider environmental benefits to include the value of CO_2 emissions abatement across New York, New England, Ontario, and PJM that would result from a proposed project. Economic benefits would include reductions in fuel costs, variable O&M costs, and any other generation costs besides emissions allowance costs across the same region.[4]
- Reliability Benefits – A large share of the reliability benefits of the transmission projects are embedded in the quantification of economic benefits, including reducing congestion that can arise as resources are dispatched to satisfy the system's real-time reliability needs. However, this analysis does not capture the additional potential benefits of improving resource adequacy by making resources more deliverable. These additional reliability benefits are best measured by how the projects affect the loss of load

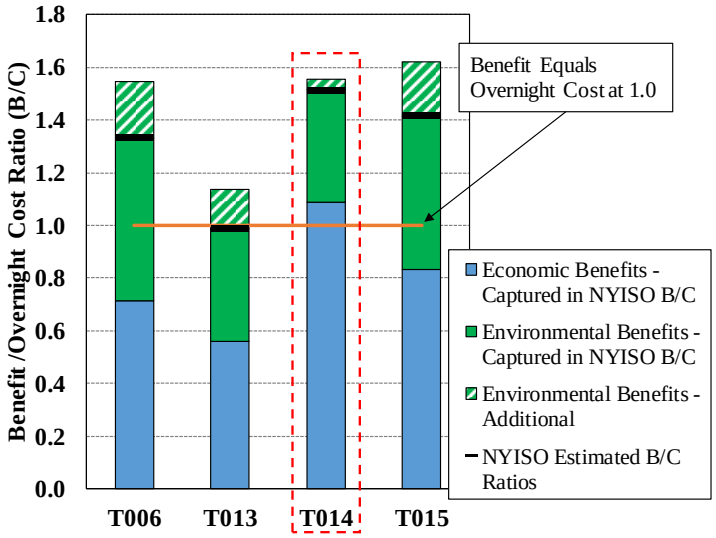
[4] Although the Economic and Environmental Benefits are based on the GE MAPS simulations, the sum of these benefits is not equal to the NYCA Production Costs Savings discussed in Table 4-1 of the WNY PPTP Report because NYCA Production Costs do not consider the benefits of emission reductions in neighboring areas with no CO_2 pricing regime. 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.

expectation ("LOLE"). However, the NYISO found that none of the proposed projects would have improved LOLE significantly. This indicates that the resource adequacy benefits of these projects would be negligible, although they likely produce other reliability benefits.[5]

The NYISO also identified several qualitative benefits categories, including (a) Performance – How the proposed project may affect the utilization of the system (e.g. increased Niagara and Ontario generation), and (b) 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 found that projects with phase-shifting transformers and projects that are more integrated with the existing grid provide operational flexibility superior to other projects. Some of these qualitative metrics are reflected in the GE MAPS simulations, so they are partially reflected in the economic and environmental benefits.[6] Section II.C.discusses the use of these metrics in detail.

Summary of Assessment of Cost and Benefits for Tier 1 Projects

The following figure summarizes the NYISO's economic and environmental benefits for the four Tier 1 projects and shows benefit-cost ratios the NYISO calculated based on its production cost savings estimates for one scenario. Environmental benefits are broken into two categories: one indicating the environmental benefits that are reflected in the NYISO's benefit-cost metric, and one indicating additional environmental benefits from CO_2 abatement in areas with no CO_2 pricing regime. The Performance and Operability metrics are reflected in this figure to the extent that they influence the results of the GE MAPS simulations. The bars shown in the figure are for Scenario 2, which assumes that a federal CO_2 program is implemented in 2024 and which was utilized by the NYISO for *Table 4-1: Summary of Results*.



5 Note, transmission facilities can also provide transmission security benefits in the planning horizon or in market operations. The WNY PPTP Report did not quantify the monetary value of transmission security benefits in the planning horizon from the proposed projects. In market operations, the benefits of improved transmission security would reduce the cost of generation re-dispatch to manage transmission constraints, so these benefits are largely included in the results of the GE MAPS simulations. In Section II.C, we discuss certain caveats that may lead the GE MAPS simulations to under-estimate the value of congestion relief.

6 Note, in Section II.C, we discuss certain caveats that may lead the GE MAPS simulations to under-estimate the value of performance and operability during certain market conditions.

The results in this figure support several key conclusions:

- The proposed projects would provide significant environmental benefits by increasing utilization of the Ontario generation fleet, which has low marginal costs and low CO_2 emissions-intensity relative to the adjacent U.S. markets.
- A large share of the production cost savings measured in the NYISO's B/C ratios using the GE MAPS model are actually environmental benefits. This is because CO_2 pricing programs provide generators with incentives to incorporate the marginal value of CO_2 emissions abatement in their offers.
- The overall benefits of the proposed transmission is dependent on the future prices of CO_2 allowances in the respective regions with higher allowance prices implying higher environmental benefits.
- Tier 1 projects exhibit estimated economic and environmental benefits that exceed their estimated overnight cost. Projects T006, T014, and T015 exhibit similar overall B/C ratios with Project T014 exhibiting higher economic benefits and lower environmental benefits than the other two.
- Because the B/C ratio for Project T014 is greater than 1.0 based purely on its economic benefits, the finding that it is economic is less subject to uncertainties regarding future allowance prices.

As discussed above, our assessment of whether the project will adversely affect the market is based on whether the project's benefits are expected to exceed its costs. An uneconomic project would be harmful because it would undermine the current and future market prices, which are critical for providing incentives to govern long-term investment and retirement decisions. Thus, we find that the recommended project (T014) appears to satisfy a basic cost-benefit test under a variety of conditions, allowing us to conclude that it will not adversely affect the NYISO wholesale electricity markets. Given these cost-benefit results and the other factors considered by the NYISO, we find that NYISO's recommendation is reasonable.

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. While some of these factors, if considered, would have increased the B/C ratios, others would have reduced them. Ultimately, if all of these factors were addressed, it is unlikely that it would affect the finding that the recommended project would be cost-effective. Section II.C discusses these factors in greater detail.

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. Nonetheless, 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.[7] The NYISO's economic transmission planning process (CARIS) does not consider several wholesale market and 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.B of this report, we discuss a framework for quantifying the different categories of wholesale market and public policy benefits. This framework incorporates economic benefits, reliability benefits, and environmental benefits into a single metric that assists in evaluating the impact on wholesale electricity markets from the proposed 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 economic for purposes of this evaluation is: *the priced and unpriced benefits of the project exceeds its costs.*

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

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 will be more likely to be economic if the PPTN is defined in a manner that is focused on the ultimate public policy objective, and 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 amount of additional transmission desired to achieve a public policy objective, it would be better for the PPTN to specify the ultimate objective. This would allow developers to propose more creative and cost-effective solutions.

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. In this case, for example, these qualitative factors provide additional support for the NYISO's recommendation of Project T014.

B. 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 Project T014. 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 how we consider the results of the metrics that the NYISO used to assess the effects of each project. 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 the qualitative metrics that the NYISO uses to assess each project.

1. Economic, Environmental, and Reliability Benefits

The NYISO employed a diverse set of metrics for satisfying the PPTN, which can be used to assess the economic, environmental, and reliability benefits that would come from transmission investment in western New York.

Environmental benefits – The primary environmental benefit from the proposed transmission projects is that they would allow zero-emission and relatively low carbon-intensity generation in Ontario to generate more for export to New York. This would reduce the amount of generation

from New York, New England, and PJM, which is typically produced by higher carbon-intensity generation. Consequently, additional transmission in western New York would reduce overall CO_2 emissions. The NYISO estimated the value of CO_2 emissions reductions using projected CO_2 allowance prices in Ontario, Quebec, New York, New England, and PJM. Thus, these environmental benefits are reflected in the GE MAPS production cost savings to the extent that the simulations treated CO_2 allowance prices as a cost of generation.[8]

Economic benefits – The primary economic benefit from the proposed transmission projects is that it allows increased generation from sources with low fuel and variable O&M costs, which displaces generation from higher-cost sources. This production cost savings is measured using GE MAPS software. 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 Tier 1 projects based on GE MAPS simulations, same as the NYISO. However, we calculate the benefits slightly differently and attempt to distinguish between the purely economic benefits and the environmental benefits. These two classes of benefits are both included in the NYISO's single production cost savings value. 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
  - NYCA Production Cost Savings = $26 = $28 reduction of generator costs minus $2 increase = Environmental Benefit + Economic Benefit
- Example 2 – An Ontario 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

[8] Most of the NYISO's scenarios assumed a federal CO_2 allowance program would be implemented in the fourth year of the study (i.e., 2024), so these benefits are not quantified in the production cost savings from the GE MAPS model from 2021 to 2023. However, in Scenario 8, the NYISO assumed no federal CO_2 emission pricing program for the entire study period.

- NYCA 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 NYCA 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 from 2021 to 2023 in most of the GE MAPS scenarios), the production costs savings would exclude the value of emission reductions in such areas. [9]

Reliability benefits – 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. The GE MAPs simulations capture a substantial share of these reliability benefits. However, the simulations do not capture the resource adequacy benefits, which are primarily reflected in the capacity market and the revenues it produces for generators and demand response resources. Resource adequacy benefits can be measured by the loss of load expectation ("LOLE"), which is the resource adequacy metric used in the NYISO planning models. Therefore, it is possible to value the resource adequacy benefits from new transmission by measuring how much generation or demand response would be compensated for providing an equivalent LOLE improvement.[10] The NYISO found that none of the proposed projects would have improved LOLE significantly, implying that the resource adequacy value of these projects would be negligible. However, the magnitude of these resource adequacy benefits may be much larger in a future PPTP evaluation.

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

We have reviewed the GE MAPs simulation analyses of the Tier 1 public policy transmission projects. Using these simulation results and the project costs presented in the NYISO report, we calculated the economic and environmental benefits for each project and compared these benefits to the project costs. The NYISO also calculated benefit-cost ratios for each project and used these results along with its assessment of qualitative benefits to recommend one of the Tier 1 projects, Project T014.

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9 In principle, the NYCA Production Cost Savings would also differ because they measure changes in the cost of imports rather than changes in generation costs in neighboring regions. However, we used changes in the cost of imports as a proxy for changes in the generation costs in neighboring regions.

10 Note, transmission facilities could also provide transmission security benefits in the planning horizon or in market operations. The WNY PPTP Report did not quantify the monetary value of transmission security benefits in the planning horizon from the proposed projects. In market operations, the benefits of improved transmission security would reduce the cost of generation re-dispatch to manage transmission constraints, so these benefits are largely included in the results of the GE MAPS simulations. In Section II.C, we discuss certain caveats that may lead the GE MAPS simulations to under-estimate the value of congestion relief.

Figure 1 summarizes the NYISO's economic and environmental benefits for the four Tier 1 projects, and shows the benefit-cost ratios the NYISO calculated based on its production cost savings estimates. Environmental benefits are broken into two categories: one indicating the environmental benefits that are reflected in the NYISO's production cost savings metric (which was used to calculate the B-C ratios), and one indicating additional environmental benefits from CO_2 abatement in areas with no CO_2 pricing regime. The bars shown in the figure are for Scenario 2, which assumes that a federal CO_2 program is implemented in 2024 and which was utilized by the NYISO for *Table 4-1: Summary of Results*.

We find that it is appropriate to rely more on Scenario 2 than the base case scenario for evaluating the economics of the Tier 1 projects because Scenario 2 reflects recent additions to the transmission system that were not in service when the proposals were submitted.[11] Nevertheless, the NYISO found that its other scenarios were generally supportive of the conclusion that T014 was the superior project.

Figure 1: Results for Tier 1 Projects

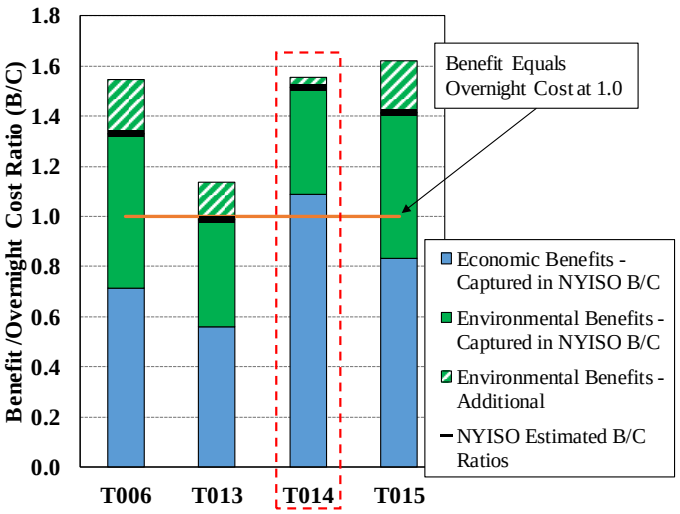

Figure 1 shows that the aggregate economic and environmental benefits we calculate are slightly higher than the production cost benefits reported by the NYISO. To the extent that the areas modeled in the simulations include a CO_2 pricing program, the NYISO's production cost savings will include the value of the CO_2 emissions reductions. This is the case because generators located in areas with a CO_2 program will include the cost of emission allowances in their offers, just as they do with fuel or other types of production costs. In our results, we separate these environmental benefits from the residual economic benefits included in the production cost savings. For those areas that are not covered by a CO_2 program, we estimated environmental benefits that were in addition to the production cost savings reflected in GE MAPS. [12]

These results indicated that each of the proposed projects would provide significant environmental benefits. These benefits are achieved by increasing utilization of generation in Ontario, which generally exhibits lower production costs and lower CO_2 emissions-intensity relative to the adjacent U.S. markets. Therefore, increased imports from Ontario will displace

11 Specifically, Scenario 2 includes the series reactors at Huntley, which modify the pattern of flows across the transmission system in Western New York.

12 This calculation is described in Section II.B.1.

higher-emitting generators in the U.S. and result in lower CO2 emissions. In fact, our analysis shows that a large share of the production cost savings measured in the NYISO's B/C ratios using the GE MAPS model are actually environmental benefits. These benefits are determined by the future prices of CO_2 allowances in the respective regions. Hence, uncertainty regarding future allowance prices will translate to comparable uncertainty regarding the environmental benefits. The economic benefits also depend on future conditions and factors that are uncertain, such as future fuel prices. However, the uncertainty of the economic benefits are likely lower than the uncertainty of the environmental benefits.

Overall, our analysis of the economic and environmental benefits and costs of the Tier 1 projects lead to the following key conclusions:

- Each of the Tier 1 projects exhibit estimated economic and environmental benefits that exceed their estimated overnight cost.
- Projects T006, T014, and T015 exhibit similar overall B/C ratios. However, Project T014 exhibits higher economic benefits and lower environmental benefits than the other two projects.
- Because the B/C ratio for Project T014 is significantly greater than 1.0, we find that this project will not harm the NYISO wholesale electricity markets.
- Additionally, because T014 exhibits a B/C ratio greater than 1.0 based purely on its economic benefits, the finding that it is economic is less subject to the uncertainty associated with future allowance prices.
- For each of these reasons, we find that the NYISO's recommendation of Project T014 is reasonable and consistent with its mandate under the PPTP process.

Although our evaluation of the costs and benefits is consistent with the NYISO's evaluation and we find its recommendation to be reasonable, we nonetheless provide a discussion in the next two subsections of the NYISO's qualitative metrics and the assumptions it used in calculated the costs and benefits of the PPTPs.

3. 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 WNY PPTP Report, this was based on the amount by which a project would increase Ontario imports plus Niagara generation. Initially, the NYISO estimated these amounts under four

scenarios varying the amounts of generation from the Niagara generator and wind generation in western New York. The estimated economic and environmental benefits of this performance is largely reflected in the production cost savings, since the GE MAPS model varies output from Niagara and wind generation over the study period, so the qualitative assessment of Performance is not an entirely distinct benefit. Moreover, the GE MAPS model estimates how much of the additional capability would likely be used. Later, the NYISO examined how its Performance metric would vary under certain transmission outage conditions, which was instructive since the NYISO's GE MAPS scenarios do not include transmission outages.

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 found that projects with phase-shifting transformers and projects that are more integrated with the existing grid provide operational flexibility superior to other projects. We believe that a large share of the benefits of this operability metric are already reflected in the GE MAPS simulations. However, operational flexibility may become more 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, although the NYISO assessed that this is not a significant distinguishing factor for the Tier 1 projects.

Permitting and other risks to the project timeline. The permitting agency may require changes that increase the overnight or life 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, however, the NYISO's evaluation does not consider project financing costs or how the estimated duration of development would affect the net present value of production cost savings.

C. 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 addressing these factors:

- Would *not* affect our conclusion that the recommended project would be economic and would not adversely affect the NYISO markets; and

- Would affect the proposed projects relatively uniformly and, thus, would likely have had limited effects on the overall ranking of projects.

However, these factors may be 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. We find that the NYISO costs estimates are reasonable in this evaluation, but recommend the following improvements in estimating project costs in future PPTP evaluations.

First, the NYISO's evaluation does not consider non-capital costs such as O&M costs that would be incurred by proposed projects, although these are a significant portion of the life cycle costs of the project. To illustrate, in the AC Transmission Proceeding, the Brattle Group estimated that the O&M costs for transmission projects typically add ~23 percent to the net present value of the project's revenue requirement.[13] The final revenue requirement associated with any transmission asset would reflect the asset's O&M cost, so not incorporating this cost in the B/C metric could lead to overstating the efficiency of the proposed projects. However, incorporating O&M costs would not likely influence the conclusions in this case.

Second, the NYISO's evaluation considers only the initial capital costs and does not account for the life cycle capital costs of the new equipment. Some of the proposed projects would utilize equipment that have higher life cycle costs than others. For instance, some commenters indicated that the choice of wooden poles (versus steel poles) would reduce overnight costs while

[13] 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

increasing life cycle costs. Thus, consideration of life cycle costs could result in a more accurate benefit-cost ratio of certain projects and provide incentives for more economic projects.[14]

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 indicated that the NYISO's cost estimates are significantly different from their own estimates. For instance, one developer indicated that SECO's cost estimate was ~20 percent higher than its own estimate.[15] 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 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 assumed regarding the mix of resources in NYCA and neighboring regions over the study period. The NYISO utilized the 2016 CARIS Phase 2 database and made several changes to it for the purpose of production cost simulations.[16] 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, the NYISO assumes new entry would occur such that the system meets the minimum resource adequacy standard throughout the study period (i.e., that LOLE does not exceed one day in ten years). As a result, the NYISO capacity market is designed to incentivize investment to maintain a small excess capacity margin, so the average LOLE would not be expected to

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14 See July 25th 2017 comments of North American Transmission on Draft Western New York Public Policy Transmission Planning Report available at: http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_espwg/meeting_materials/2017-07-27/NAT%20Comments%20Attachments%207%2025%2017%20Public.pdf

15 *Ibid*.

16 See NYISO's response to question 1 (page 2) in its January 31st 2017 FAQ document available at: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Planning_Studies/Public_Policy_Documents/Western_NY/WNY_PPTN_Phase_2_FAQ_Final.pdf

exceed 0.7 days per ten years.[17] Consequently, the NYISO assumes an unrealistically low capacity margin from 2026 to 2040 in its evaluation. The lower the capacity margin leads to higher the estimated production cost savings, which may overstate the economic benefits of the project. Based on our examination of the annual production cost savings estimates, if the NYISO used more realistic assumptions about the excess capacity margin, we would expect roughly a ~10 percent reduction in the NPV of the economic and environmental benefits over the period. This reductions would not change the conclusions of our evaluation.

Second, the NYISO's GE MAPS and GE MARS scenarios did not consider how new transmission lines would affect future entry and exit decisions by generators, although one of the principal rationales for Order 1000 was to facilitate certain public policy objectives, such as promoting the development of new renewable generation.[18] Thus, we recommend that the NYISO incorporate a model for entry and exit decisions of renewable and fossil-fuel generators upstream and downstream of the constraint in its future PPTP assessments.[19]

Third, the NYISO also assumed that Fitzpatrick and Ginna nuclear units will retire, while Indian Point will continue to operate during the evaluation period. There are several clear indicators that would justify alternative assumptions about the future operation of these three plants.[20] The assumptions regarding new entry and the nuclear units' operation most likely increase the estimated production cost savings for all the proposed projects.

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17 See page 55 of the *2016 State of the Market Report for the New York ISO Markets* by Potomac Economics available at: http://www.nyiso.com/public/webdocs/markets_operations/documents/Studies_and_Reports/Reports/Market_Monitoring_Unit_Reports/2016/NYISO_2016_SOM_Report_5-10-2017.pdf

18 Notwithstanding, the NYISO's Expandability metric does consider the impact of the proposed solution on future construction potential and the extent to which any subsequent expansion of the system will continue to use a proposed transmission project. However, this metric does not attempt to quantify the economic, environmental, and/or reliability value of future expansion.

19 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 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.

20 Under the Zero Emissions Credit program of the Clean Energy Standard, the three upstate nuclear plants (Fitzpatrick, Ginna and Nine Mile) will receive payments for every MWh produced by the plants. See the NYPSC's Order approving the program at http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B44C5D5B8-14C3-4F32-8399-F5487D6D8FE8%7D. Consequently, the plant economics are likely to be favorable enough to continue their operations. For instance, the Fitzpatrick unit was refueled and continues to operate beyond its proposed retirement date of January 2017.

The State of New York and the owner of the Indian Point facility have indicated that they reached an agreement in which the two remaining reactors would be permanently retired by 2021. See http://www.entergynewsroom.com/latest-news/entergy-ny-officials-agree-indian-point-closure-2020-2021.

Ultimately, if the NYISO implemented the first two recommendations listed in this subsection, it would make the estimated benefits less sensitive to the NYISO's assumptions regarding the status of any particular unit such as Fitzpatrick or Ginna. This is because the exclusion of an existing generator (e.g., Fitzpatrick) 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, loop flows that move around Lake Erie and through the West zone are highly variable, and have contributed to significant price volatility in the recent years. However, this source of variability is not modeled in the GE-MAPS simulations used by the NYISO. Considering loop flow and unforeseen variations in other non-modeled flows would likely reveal additional benefits from the new transmission lines. This is underscored by the fact that the most severe congestion in Western NY arises during periods with significant clock-wise loop flow around Lake Erie.[21] Furthermore, the NYISO performed two scenarios in which GE MAPS was run holding flows constant at 2013 levels between Ontario and the MISO constant. These scenarios resulted in higher levels of exports from Ontario to the NYISO and, thereby, 15 to 62 percent higher production cost savings from each Tier 1 project.[22] Thus, these two scenarios support the contention that the benefits from additional transmission in Western New York would rise if the variability of loop flows was modeled.

Second, 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

21 See Appendix Section III.D of the *2016 State of the Market Report for the New York ISO Markets* for a discussion of the impact of loop flows on West Zone congestion.

22 See WNY PPTP Report, Table 3-19 Historical IESO-MISO Flow Modeled results versus 2017 Baseline results. Also see Table 3-20 results versus Table 3-19 SR on 77/78 In-Service results.

export-congestion from the North Zone is caused by transmission outages.[23] Moreover, in the AC Transmission Proceeding, the Brattle Group report found that transmission outages and other unforeseen factors led actual market outcomes to exhibit 56 percent more congestion than the GE MAPS model would simulate.[24] Considering such factors would significantly increase the estimated benefits of new transmission.[25] We recommend that future production cost simulations incorporate such factors.

Third, 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.

23 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*.

24 See slide 84 of the Brattle Group's September 15th 2015 presentation on *Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades*.

25 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.

III. CONCLUSIONS

The NYPSC issued an order identifying a PPTN related to congestion in western New York. It directed the NYISO to consider solutions that would provide access to increased output from Niagara and additional imports from Ontario. The NYISO, in accordance with the PPTP component of its comprehensive system planning process, evaluated 12 projects that were proposed to address the western New York 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 project.

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 the NYISO's recommended project (Project T014) is economic under a variety of conditions, allowing us to conclude that it will not adversely affect the NYISO wholesale electricity markets. Additionally, the NYISO also assesses qualitative factors that are not fully reflected in the quantified benefits, which further supports the NYISO's selection of Project T014.

This is the first public policy transmission evaluation performed by NYISO. In general, we found the NYISO's methodologies for this assessment to be sound. 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.A
Include non-capital costs and life cycle capital costs in the B/C metric.	II.C.1
Develop tariff provisions for allowing developers to take on risk of project cost overruns.	II.C.1
Model entry and exit decisions for generators in a manner that is consistent with the expected competitive market outcomes.	II.C.2
Refine assumptions for future operation of key plants in New York based on latest available information.	II.C.2
Consider modeling variability resulting from loop flows around Lake Erie in production cost simulations.	II.C.3
Consider transmission outages and other unforeseen factors in estimating production cost savings.	II.C.3
Enhance quality of natural gas and emission allowance price forecasts.	II.C.3