STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

CASE 22-E-0633 **In the Matter of New York Independent System Operator, Inc. Proposed Public Policy Transmission Needs for Consideration for 2022**

COMMENTS OF POTOMAC ECONOMICS, LTD.

Pursuant to the New York Public Service Commission's ("Commission") Notice of Proposed Rulemaking "Proposed Public Policy Transmission Needs/Public Policy Requirements, As Defined Under the NYISO Tariff" published in the December 21, 2022 edition of the New York State Register (I.D. No. PSC-51-22-00001-P), Potomac Economics respectfully submits its comments in the above-captioned proceeding.

Potomac Economics serves as the Market Monitoring Unit ("MMU") for the New York Independent System Operator, Inc. ("NYISO"). The NYISO Market Services Tariff requires the MMU to help ensure that the NYISO's markets are created and operated in a "robust, competitive, efficient and non-discriminatory" manner.[1] As the MMU, we are also responsible for reporting on "the use of the New York State Transmission System as such system affects or may affect competitive conditions in or the economic efficiency of any of the New York Electric Markets".[2] The Proposed Public Policy Transmission Needs could have broad implications for

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[1] See NYISO's Market Administration and Control Area Services Tariff ("Market Services Tariff" or "MST") Attachment O §30.1.2.

[2] See MST Attachment O §30.1.1

all of New York's electricity markets. Therefore, good cause exists to permit Potomac Economics' motion to intervene in this proceeding.

I. Introduction and Summary

The NYISO received proposals from 17 parties to address transmission needs associated with Public Policy Requirements. The proposals recommend a variety of needs in many different geographic areas, ranging from unbottling of potential intra-zone generation pockets to upgrades of major cross-state interfaces. Many of the submitted proposals support their recommendations with reference to the NYISO's recently completed System & Resource Outlook (the "Outlook"). We do not discuss the specific transmission needs in these comments, although we make three recommendations related to the process and criteria for identifying needs and selecting proposed solutions. These recommendations are summarized below.

First, the Outlook indicated that bulk transmission investments could be beneficial in the long term for reducing curtailment of renewables. But as the responses to this solicitation show, there are many potentially valuable projects and it is unclear which would advance CLCPA goals most efficiently. It would be unwise to lock in specific characteristics – such as a mandate to make a particular amount of renewable capacity in a given area fully deliverable – before analyzing the costs and benefits of a variety of competing proposals. Hence, if the Commission chooses to issue a PPTN, we recommend the Commission:

- *Declare the PPTN in general terms without including highly-specific project characteristics or quantities so that developers have greater flexibility to propose creative solutions that reduce the costs of achieving the CLCPA.*

Second, it is critical to evaluate project benefits in a realistic manner, particularly if projects with different characteristics are permitted to compete. The value of transmission depends greatly on the locations, types, and quantities of generation and load. Recognizing this in the Comprehensive Grid Planning Process ("CGPP") proceeding,[3] the Commission required the use of "capacity expansion modeling" techniques whereby generation and storage investments are assumed to rationally respond to the location of transmission bottlenecks. The use of these techniques is also extremely valuable when projects are evaluated because the project selection can and will affect where generation investment and retirements occur. Thus, we recommend that the Commission:

- *Require a project evaluation approach that incorporates capacity expansion modeling techniques*.

Third, when comparing the relative merits of competing solutions, market clearing prices from the NYISO energy, ancillary services, and capacity markets provide useful information for estimating the value of transmission and other investments. In these comments, we describe how simulations of the NYISO market can be used to estimate the net cost of increasing deliveries of renewable energy by investing in a renewable generation, energy storage, or transmission project. The proposed metric, which we call the Implied Net REC Cost, can be used to compare the value of competing projects insofar as they facilitate New York State goals of increasing use of renewable energy. Hence, we recommend the Commission require that evaluations:

- *Estimate the project's Implied Net REC Cost, which allows comparison of each project's cost-effectiveness at advancing state goals compared to competing investments*.

Section II discusses our recommendation regarding identification of a PPTN. Section III proposes evaluation methodologies for the Commission to require in the comparison of proposed solutions to a PPTN. Section IV summarizes our conclusions and recommendations.

3 Order on Local Transmission and Distribution Planning Process and Phase 2 Project Proposals, issued September 9, 2021, Case 20-E-0197, at p. 12.

II. Comments on Identification of Public Policy Transmission Needs

Our first recommendation would help the Commission avoid establishing an overly restrictive PPTN. In particular, we advise against issuing a PPTN structured as a need to upgrade a specific facility or interface, or as a requirement to make a specific amount of capacity in an area fully deliverable without any hours of curtailment. An overly restrictive PPTN will preclude developers from proposing the most cost-effective projects and could lead to investment in an uneconomic project. Ultimately, an overly restrictive PPTN will raise the costs of achieving the CLCPA by needlessly limiting the range of possible solutions.

There are many combinations of generation, storage, local and bulk transmission projects that can achieve the goals of the CLCPA. It is in the State's interest to pursue the most efficient combination of projects possible – not only to minimize the burden on ratepayers, but to ensure that each dollar of ratepayer funding goes further in advancing clean energy targets. The best way to do this is by maximizing competition between available options.

PPTN solicitations with specific viability and sufficiency (V&S) criteria limit developers' flexibility to customize their proposals, which inhibits competition. For example, a project was rejected at the V&S phase of the ongoing Long Island PPTN process because it narrowly failed to eliminate overloads on a single facility under 'light load' conditions with all 3 GW of offshore wind assumed to be operating at 100 percent output.[4] Such a condition is likely to occur in a very small number of hours and in practice can be mitigated by storage charging or minor amounts of curtailment. Although we did not evaluate the merits of this proposal, it is theoretically possible that this project would have been a cost-effective option that would have

[4] See NYISO, "Long Island Offshore Wind Export Public Policy Transmission Need Viability & Sufficiency Assessment", April 5, 2022, at 18-19. The Downstate Clean Powerlink project proposed by Anbaric Development Partners, LLC was found to be not sufficient due to a 114 percent N-1-1 loading of the Sprain Brook – Shore Road line under light load conditions.

substantially achieved the goals of the PPTN. However, the prescriptive nature of the solicitation excluded it from being evaluated, reducing the number of competing developers from four to three.

An overly-tailored PPTN would limit competition from a wide variety of projects that could potentially contribute to the 70x30 and 100x40 goals. For example, multiple parties proposed a PPTN to unbottle renewable generation in the Southern Tier area (the "Z1" and/or "Z2" pockets in the Outlook study). The Outlook anticipates 0.2 to 1.0 TWh renewable curtailment in this area by 2030 and 2.1 to 2.3 TWh by 2035, assuming 3.3 to 4.3 GW of wind and solar enter there by 2035. But a PPTN to make this amount of capacity fully deliverable would likely not be cost-effective because:

- There is no guarantee that the amounts and locations of entry assumed in the Outlook will actually occur – A robust assessment with capacity expansion modeling (as we describe in the next section) would be needed to evaluate how generation and storage investments are likely affected the presence or absence of transmission upgrades. These responses are key for determining the most valuable transmission upgrades.
- Transmission investment in other areas might be more cost-effective after accounting for shifts in generation and storage investments – No analysis has been done that considers costs and benefits of alternative combinations of projects.[5] A narrowly tailored PPTN could exclude potentially beneficial projects.
- Even if future clean resource investment could be predicted perfectly, reducing curtailment through transmission investment alone is unlikely to be cost-effective.

The following two figures illustrate how an overly-restrictive PPTN could lead to the selection of inefficient solutions and undermine incentives for competing technologies such as battery storage. Figure 1 shows a hypothetical PPTN to eliminate curtailment of renewable

5 The Outlook did not consider the costs of addressing identified bottlenecks, nor did it consider how generation and storage investments might adjust based on potential transmission solutions. The Power Grid Study found little bulk system congestion before 2040 but did not consider constraints on lines below 230 kV, which had significant congestion in the Outlook.

generation from an export-constrained area by requiring an additional 2.4 GW of transmission investment. The figure shows an example day when wind and solar capacity in the area is limited by the export constraint from Hour 1 to 19. 'Project 1' would increase the initial 1.5 GW transmission limit by 1.6 GW, allowing 94 percent of the renewable generation in the pocket to be deliverable. The remaining 6 percent of curtailed output would occur in a six-hour window from Hour 10 to 15 and might be largely addressed by battery storage investment inside the pocket.[6] A PPTN to make all generation deliverable up to the "Zero Curtailment" limit would require an additional 740 MW of transmission (a 46 percent increase over the size of Project 1) while increasing the amount of deliverable energy by only 6 percent. A solicitation with a more flexible PPTN would allow the modest curtailment under Project 1 to be considered in the evaluation stage alongside the cost savings it provides.

Figure 2 shows annual renewable output and curtailments as an hourly duration curve, using the same renewable capacity and transmission limits as Figure 1. It is uncommon for both the wind and solar resources to simultaneously generate at maximum capability, so the maximum 3.9 GW of output occurs in a small number of hours. As a result, a requirement for zero curtailment increases the annual supply of deliverable renewable energy by only 0.2 percent compared to the Project 1 Limit, despite requiring a 46 percent larger transmission upgrade.

[6] NYISO market prices provide strong incentives for storage to enter near renewables facing curtailment, because the storage project can earn large revenues by charging when energy prices are negative.

Figure 1: Renewable Output and Curtailment on a Single Day

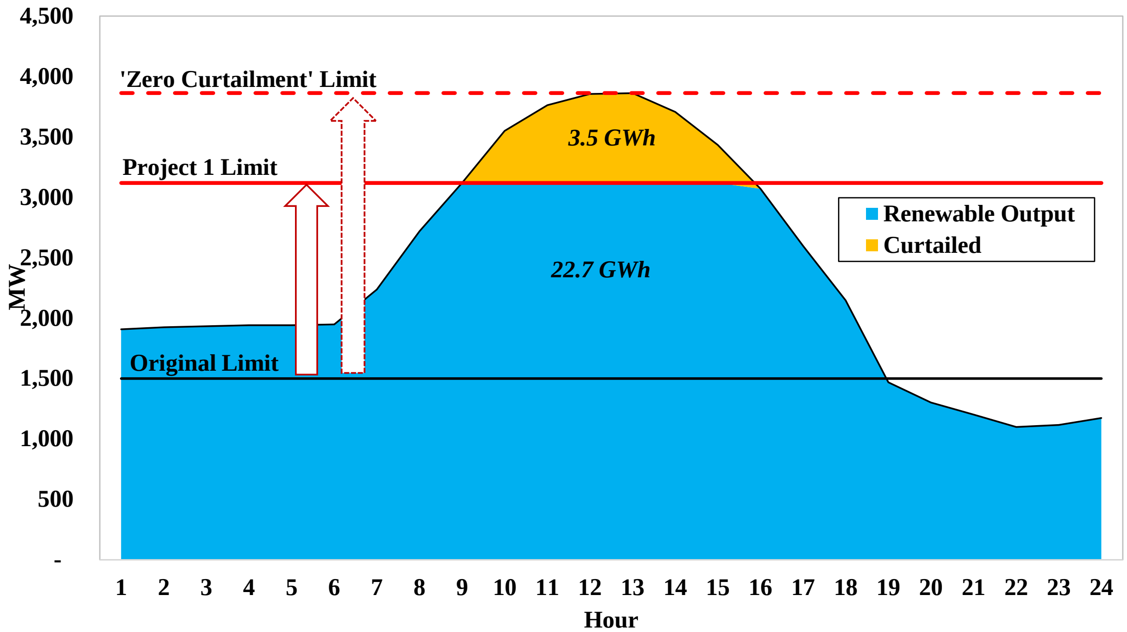
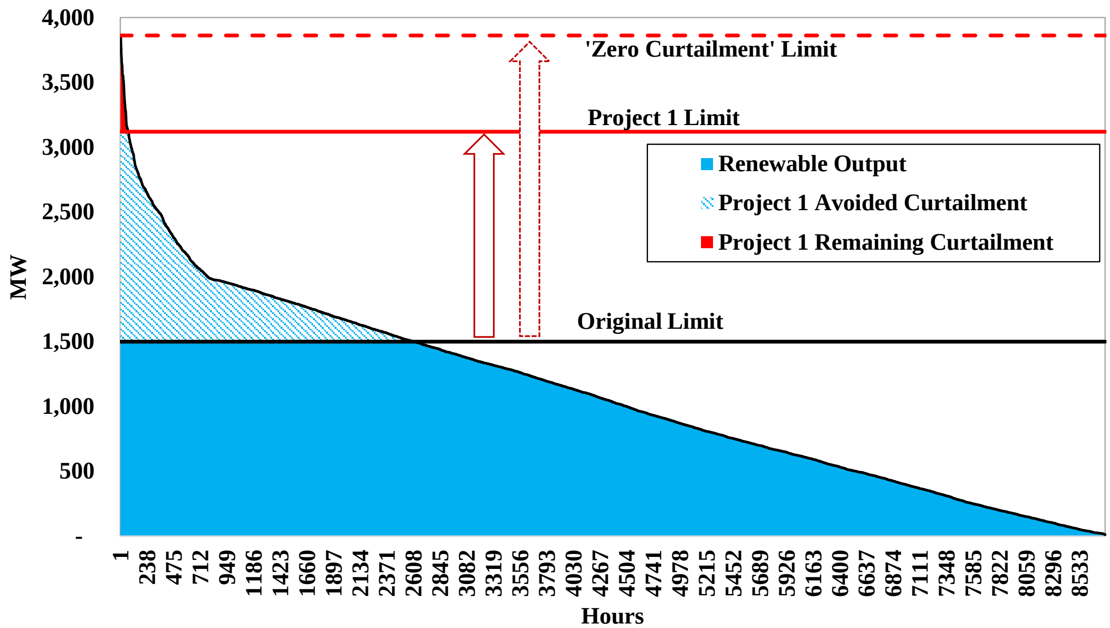


Figure 2: Renewable Output and Curtailment – Annual Duration Curve



These figures show how establishing a rigid objective can result in the proposal and selection of projects that are costly and inefficient. Hence, if the Commission chooses to issue a PPTN, we recommend structuring it to maximize the competition among cost-effective proposals. Specifically, we recommend avoiding requirements to upgrade specific facilities or to make a predefined amount of renewable capacity fully deliverable. For example, it would be better to require that a certain amount of renewable *energy* be made deliverable rather than requiring that a certain amount renewable capacity be *completely* deliverable or subject to no curtailment under any conditions. This will prevent cost-effective projects from being discarded at the V&S stage. This will allow developers to seek out the most valuable opportunities to advance the CLCPA through bulk transmission and creatively propose projects. This style of PPTN should be paired with evaluation techniques designed to select the most efficient projects, which we discuss in the following section.

III. Comments on Evaluation of Proposed Solutions

a. Evaluations should use capacity expansion modeling techniques to consider impacts on generation and storage investment

The NYISO evaluates benefits of PPTN projects using models that depend on assumptions about future generation and storage investments. The most recent evaluation (for the ongoing Long Island Offshore Wind Export PPTN solicitation) used an approach in which a future resource mix is developed ("base case"), and project benefits are then calculated by modeling the system with and without the proposed project, holding all else constant ("static approach"). This 'static approach' is problematic because it does not consider that the locations of generation and storage investments would be influenced by new transmission projects that would alleviate congestion on specific corridors. As a result, the static approach will:

- Undervalue project benefits if the project would enable more renewable investment in a formerly bottled area, compared to the amounts assumed in the base case.
- Overvalue project benefits if the base case includes more renewable capacity upstream of a bottleneck than would realistically choose to site there.
- Fail to consider how the potential for market-based storage (which has much shorter development lead times) will affect the optimal sizing of transmission upgrades.

For example, suppose that if transmission 'Project 1' is built to facilitate exports from 'Pocket A', 3 GW of wind and solar would efficiently be built in Pocket A. If the base case (developed *before* considering the impacts of Project 1) includes only 500 MW of renewables in Pocket A because it is congested, the evaluation will undervalue Project 1. If the base case includes 5,000 MW of renewables in Pocket A (ignoring the high congestion these resources would face), the evaluation will overvalue Project 1. In both cases, it is inaccurate to evaluate Project 1 without considering its impacts on generation and storage investments.

The NYISO's recent Outlook study provides a useful high-level view of where transmission investments could be valuable. But it has key limitations for evaluating individual projects when treated as a static resource mix forecast. The Outlook improved on earlier studies by using a zonal capacity expansion model, but it largely assigned new renewables to the sites of current interconnection queue projects, even when some experienced high marginal curtailment rates.[7] This is helpful for understanding how transmission limitations affect current areas of developer interest, but likely does not represent the most efficient mix of generation investments in the absence of transmission expansion. The Outlook also did not model storage projects entering at locations that reduce curtailment, even when it would be profitable to do so.[8] As a result, the Outlook cases serve as a useful starting point but the new resource entry assumptions should be modified to better reflect where investors would locate generation and storage projects taking into account the proposed transmission project.

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7 A capacity expansion model develops a forecast of generation investments based on economics, and it can be designed to include requirements such as meeting state renewable energy targets. The capacity expansion model used in the 2021 Outlook has a zonal level of granularity and does not explicitly consider constraints on the amount of resources that can enter intra-zonal generation pockets without incurring significant curtailment.

8 See "MMU Review of 2021-2040 System Outlook", August 24, 2022, available here.

Hence, we recommend that the Commission require PPTN projects to be evaluated using an approach in which the future mix of generation and storage investments adjusts in response to the proposed transmission project. This can be done using a capacity expansion model that alters generation and storage investment assumptions considering the un-bottling resulting from the proposed project.[9] The Commission has previously endorsed this approach and rejected an approach to evaluating benefits of local transmission projects based on a static generation mix, leading to the development of the Comprehensive Grid Planning Process ("CGPP") currently underway.[10] There is no reason to apply less analytical rigor to evaluating the benefits of bulk transmission than local transmission.

b. Evaluations should consider projects' Implied Net REC Costs

We disagree with comments on evaluation criteria by AES Clean Energy arguing that the transmission network should be designed to deliver all generated energy.[11] Transmission investments are costly and it is highly inefficient to plan a system in which no congestion and curtailment ever occur. It will sometimes be less costly to simply procure more generation and/or storage capacity to make up for the fraction of output that is curtailed than to build a transmission line. Hence, we recommend an evaluation approach designed to select transmission

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9 Major interfaces will generally be represented as zonal transfer limits in a capacity expansion model, as in the Outlook study. When intra-zone generation or load pockets are relevant, these should be represented in the capacity expansion model so that base and project case buildouts in the pocket consider transmission limitations. This could entail creating a 'zone' in the capacity expansion model representing the subzone area with import and export limits derived from transmission flow modeling.

10 "The Commission believes a more appropriate [benefit cost analysis] should be based on long-term capacity expansion modeling that considers the costs and market revenues of various types of resources across multiple scenarios with appropriate bounds for the uncertainty of key assumptions. This capacity expansion model should be used, along with screening criteria, in an iterative process to arrive at the most cost-effective set of LT&D upgrades with associated bulk or LT&D connected renewable resources, and integrated with the statewide planning process required by this Order". See "Order on Local Transmission and Distribution Planning Process and Phase 2 Project Proposals", issued September 9, 2021, Case 20-E-0197, at p. 12.

11 AES Clean Energy 2022 PPTN Proposal, at p. 8.

projects if and only if they advance policy goals cost-effectively. Ultimately, this will allow the delivery of more renewable energy at lower costs for New York's consumers.

To this end, we recommend that the Commission require evaluation criteria to include the Implied Net REC Cost of each proposed transmission project. The Implied Net REC cost, denominated in dollars per megawatt-hour, refers to the net cost of making incremental renewable energy available to load through an investment in renewable generation, storage, or transmission.

The advantage of estimating the Implied Net REC Cost of regulated transmission is that it directly compares the project's efficiency at advancing state goals to other projects and technologies using a common metric. Transmission projects with Implied Net REC Costs that are lower than those of generation and storage represent opportunities to reduce the cost of achieving the CLCPA through a regulated project. When the Implied Net REC Cost of a transmission project significantly exceeds that of renewable generation and storage, deliverable renewable energy can be obtained more efficiently by investing in other alternatives to the transmission project. Furthermore, over-investment in costly transmission projects tends to reduce the profitability of energy storage alternatives upstream and downstream of the transmission project, so excessive transmission investment can crowd-out energy storage investment that would allow the state to meet its CLCPA goals more cost-effectively.

The Implied Net REC Cost of renewables and storage is calculated as the levelized cost net of NYISO market net revenues, divided by the annual megawatt-hours of the deliverable clean energy it provides.[12,13] A similar calculation can be performed for regulated transmission projects based on NYISO market clearing prices despite the fact that they do not earn NYISO market revenues. The Implied Net REC Cost of a transmission project is calculated as its levelized cost net of energy and capacity market benefits, divided by the incremental reduction in annual renewable curtailment it provides ("renewable deliverability impact"). These components can be calculated as follows:

- Energy benefits – The market value of the congestion relief provided by the project. This is calculated considering the project's impact on constrained transmission elements in each hour (which may or may not be project facilities), the flows over the project facilities and the shadow prices of congested elements.
- Capacity benefits – The market value of avoided generation investment that would be needed without the project. This is calculated using the marginal reliability improvement ("MRI") of the project facilities, the increase in transfer capability they provide, and the Net Cost of New Entry ("Net CONE") used to determine capacity prices, resulting in valuation comparable to a capacity market participant.
- Renewable Deliverability Impact – Annual megawatt-hours of incremental transfers of renewable energy across the project facilities and other lines whose loading the project relieves, measured during hours of curtailment due to transmission constraints. This can be calculated using generation shift factors of renewable resources and flows over the project facilities.

The table below illustrates the calculation of the Implied Net REC Cost ("INREC") for a hypothetical transmission project. In this example, the transmission project facilitates delivery of incremental renewable energy more cost-effectively than hypothetical wind and storage investments.

[12] Deliverable clean energy of a renewable resource is the annual generation potential of a MW of that resource minus the portion of generation that is curtailed or causes other resources to be curtailed. Storage projects provide deliverable clean energy by charging to reduce curtailment of renewables that would otherwise occur and discharging at a subsequent hour.

[13] For purposes of the Implied Net REC cost calculation, market revenues are calculated to exclude any positive or negative revenues incurred during hours when energy prices are negative due to curtailment of renewables earning RECs. This is to avoid double-counting the value of individual RECs.

Table 1: Example Calculation of Implied Net REC for Transmission, Wind and Storage[14]

Wind INREC

Levelized Cost	(a)	175	$thousand / year
Market Revenues	(b)	100	$thousand / year
Deliverable Energy[1]	(c)	3,000	MWh per year
Wind INREC	**(d) = [(a) - (b)]*1000 / (c)**	**25**	**$/MWh**

[1] Assumes a 1 MW wind resource with 40% capacity factor and 15% of output curtailed.

Storage INREC

Levelized Cost	(e)	90	$thousand / year
Market Revenues	(f)	70	$thousand / year
Renewable Deliverability Impact[2]	(g)	730	MWh per year
Storage INREC	**(h) = [(e) - (f)]*1000/(g)**	**27**	**$/MWh**

[2] Assumes a 1 MW battery providing 4 hours per day of curtailment relief on 50% of days.

Transmission INREC

Levelized Cost	(i)	10	$million / year
Energy Benefits	(j)	3	$million / year
Capacity Benefits	(k)	4	$million / year
Net Cost	**(l) = (i) - (j) - (k)**	**3**	**$million / year**
Renewable Deliverability Impact	(m)	200,000	MWh/year
Transmission INREC	**(n) = (l) * 1 million / (m)**	**15**	**$/MWh**

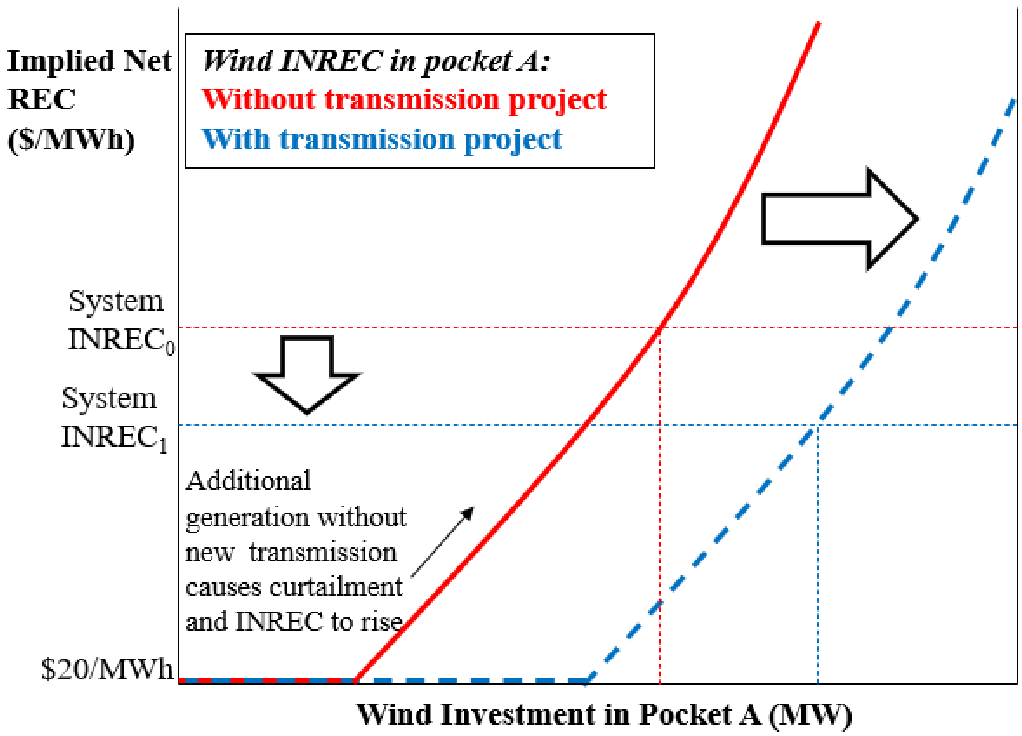
Although the example shown in Table 1 shows that the investment in transmission is the lowest-cost means to facilitate the delivery of additional renewable energy to load, this is not always the case. Performing such analyses will validate whether transmission projects are economic in meeting the State's CLCPA goals.

Figure 3 below conceptually illustrates how this approach aligns valuation of transmission projects with other investments that advance CLCPA goals. The X-axis shows the quantity of wind investment in "Pocket A" with transmission export constraints. The Y-axis shows the Implied Net REC Cost of wind in Pocket A. Larger amounts of wind investment in

[14] To calculate INREC of renewables and storage taking into account federal subsidies available to these resources, the levelized value of the ITCPTC can be netted out from their respective Levelized Cost.

the constrained pocket cause curtailment to increase, which raises the INREC cost of wind.[15] Wind investment occurs until the INREC of wind in Pocket A is equal to the 'System INREC' reflecting the cost of obtaining incremental deliverable RECs elsewhere in the system. The proposed transmission project reduces curtailment in Pocket A for any level of wind investment. This causes optimal wind investment in Pocket A to increase and the System INREC to fall, because more wind investment in Pocket A reduces the need for other renewable investments elsewhere (potentially lowering curtailment in other areas).

Figure 3: Impact of Transmission Project on Renewable Investment and REC Costs



In the example above, it is possible to calculate an INREC for the transmission project under the approach described in this section because efficient renewable investment in Pocket A results in some level of congestion even after transmission capability has increased. The use of a

[15] Curtailment raises the INREC of wind because its fixed capital and operating costs must be recovered from a smaller amount of deliverable MWhs of output, effectively reducing its capacity factor.

capacity expansion model that seeks to minimize investment costs while satisfying state targets will allow for calculation of a system INREC for a given transmission configuration. If the INREC of the transmission project is below the System INREC in the project case, it would indicate that the public policy transmission project is efficient and appropriately sized. Hence, using this metric can improve the overall public policy transmission process and lower the costs of satisfying the New York's CLCPA goals.

IV. Conclusions

Bulk transmission projects are costly but can efficiently advance policy goals if selected in a competitive and transparent manner. To that end, we respectfully recommend that the Commission:

- Avoid issuing a PPTN with highly-specific project characteristics or quantities so that developers have greater flexibility to propose creative solutions that reduce the costs of achieving the CLCPA.
- Require that project evaluations develop generation and storage forecasts using a capacity expansion model that accounts for the effects of the relevant transmission limits, as the Commission previously required in the CGPP proceeding.
- Require the calculation of the Implied Net REC Cost of proposed transmission projects and comparison to that of other projects and technologies. This will help to select projects that advance CLCPA goals at lower costs than other transmission, generation and storage alternatives.

Respectfully submitted,

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