Attachment III

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

New York Independent System Operator, Inc. **Docket No. ER22-____-000**

AFFIDAVIT OF PAUL J. HIBBARD AND CHARLES WU

I. Qualifications

A. Paul Hibbard

1. My name is Paul J. Hibbard. I am a Principal at Analysis Group, Inc. (AGI), an economic, finance and strategy consulting firm headquartered in Boston, Massachusetts, where I work on energy and environmental economic, policy, and strategy consulting. My business address is 111 Huntington Avenue, 14th Floor, Boston, Massachusetts 02199.

2. I have been with AGI for approximately fifteen years since 2003. First, from 2003 to April 2007, and most recently, from August 2010 to the present. In between, from April 2007 to June 2010 I served as Chairman of the Massachusetts Department of Public Utilities (DPU, or Department). While Chairman, I served as a member of the Massachusetts Energy Facilities Siting Board, the New England Governors' Conference Power Planning Committee, and the National Association of Regulatory Utility Commissioners (NARUC) Electricity Committee and Procurement Work Group. I also served as State Manager for the New England States Committee on Electricity and as Treasurer to the Executive Committee of the 41-state Eastern Interconnection States' Planning Council.

3. I worked in energy and environmental consulting with Lexecon, Inc. from 2000 to 2003. Prior to working with Lexecon, I worked in state energy and environmental agencies for almost ten years. From 1998 to 2000, I worked for the Massachusetts Department of Environmental Protection on the development and administration of air quality regulations, State Implementation Plans and emission control programs for the electric industry, with a focus on criteria pollutants and carbon dioxide (CO_2), as well as various policy issues

related to controlling pollutants from electric power generators within the Commonwealth. From 1991 to 1998, I worked in the Electric Power Division of the DPU on the restructuring of the electric industry in Massachusetts and formation of New England wholesale electricity markets, the setting of company rates, the quantification of environmental externalities, integrated resource planning, energy efficiency, utility compliance with state and federal emission control requirements, regional electricity market structure development, and coordination with other states on electricity and gas policy issues through the staff subcommittee of the New England Conference of Public Utility Commissioners.

4. I hold an M.S. in Energy and Resources from the University of California, Berkeley, and a B.S. in Physics from the University of Massachusetts at Amherst. My curriculum vitae is attached as Exhibit A.

B. Charles Wu

5. My name is Charles Wu. I am a Manager at AGI, also in its Boston office.

6. I have been with AGI for 6 years, since 2012. First, from January 2012 to July 2015, and most recently, from July 2017 to the present. During that period, I have worked on economic analyses of energy, capacity, and carbon allowance markets, and have designed and run models of large-scale electrical systems to evaluate market economics and simulate operations during stressed system conditions. I have designed and run simulations of transmission to predict operational efficiency and costs to consumers. I have also provided litigation support in cases related to trade disputes, mergers and acquisitions, and statistical sampling.

7. I hold a M.B.A. from the MIT Sloan School of Management, a M.A. in Economics from Northwestern University, and an S.B. in Economics from the Massachusetts Institute of Technology. My curriculum vitae is attached as Exhibit C.

II. Purpose of Affidavit

8. In its Comprehensive Mitigation Review process, NYISO is proposing changes to the BSM rules to better accommodate state objectives while maintaining the function and effectiveness of wholesale capacity markets in efficiently achieving resource adequacy in the state. The proposed changes would exclude state policy resources from BSM offer floor review, improve the accreditation of resource capacity from a reliability perspective, and include additional changes to better adapt the NYISO capacity market to the rapidly-changing state climate policy context.

9. As part of this effort Analysis Group has modeled the future operation of the NYISO capacity market under conditions consistent with NYISO's implementation of its proposed changes to the BSM rules and capacity accreditation paradigm (hereafter generally referred to as "BSM Reforms"). The analysis sought to determine whether the NYISO capacity market will continue to support the achievement of resource adequacy in the state of New York through competitive capacity market auctions administered in concert with the rollout of resources driven by New York's implementation of the provisions of the Climate Leadership and Community Protection Act (CLCPA).[1] Specifically, the analysis was designed to answer two questions:

(a) With the proposed BSM Reforms in place, will the NYISO capacity market continue to produce competitive market outcomes?

(b) With the proposed BSM Reforms in place, will the NYISO capacity market continue to provide financial incentives for the retention and addition of resources needed to maintain power system reliability?

[1] Chapter 106 of the Law of the State of New York of 2019. The CLCPA stresses that climate change is adversely affecting economic well-being, public health, natural resources, and the environment of New York State. Some of the standards established by the CLCPA include: (1) reducing GHG emissions 85% over 1990 levels by 2050, with an incremental target of at least a 40% reduction by 2030; (2) producing 70% of electricity from renewable resources by 2030 and 100% from zero-carbon resources by 2040; (3) increasing energy efficiency by 23% over 2012 levels; (4) building 6 GW of distributed solar by 2025, 3 GW of energy storage by 2035, and 9 GW of offshore wind by 2035; (5) electrification of the transportation sector, as well as water and space heating in buildings.

10. The purpose of this testimony is to summarize the results of our analysis. The purpose, approach, and results of the analysis are described in more detail in an Analysis Group report included as Attachment A to this testimony (the "Market Analysis Report").[2]

III. Overview and Summary of the Market Analysis Report

11. Our analysis simulates capacity market outcomes against the backdrop of the entry of CLCPA resources, assuming that such resources (a) will be primarily supported through out-of-market state programs, and (b) will participate in the capacity market with unmitigated offers at or near zero price (i.e., reflecting NYISO's proposed BSM Reforms).[3] We then review the results of the simulated auctions with respect to clearing auction quantities, prices, and revenue sufficiency for resources needed to meet reliability requirements.

12. Our focus is on capacity market outcomes with BSM Reforms in place over the near to medium term. Specifically, we focus primarily on market results in year one (2022) and year five (2026) following implementation of the BSM Reforms. For these years we construct forecasted supply and demand curves starting from current conditions, with adjustments to both based on expected changes in demand, reference technology costs, existing resource going-forward costs, resource entry and exit over these time periods, and the likely magnitude of additional non-mitigated CLCPA resources. In addition, we run a series of sensitivities that reflect changes to the NYISO capacity market supply and demand curves in a later year (2032), including proposed transmission changes, increases in demand curve risk premiums, and a potential alternative demand curve peaking technology.

13. Table 1 and Table 2 contain the results of the analysis for the New York Control Area (NYCA) as a whole, and for each of the NYISO capacity market localities. The results provide an indication of expected capacity market prices in dollars per kilowatt-month

[2] Paul Hibbard and Charles Wu, *Modifications to the BSM Construct in the NYISO Capacity Market - Analysis of Potential Capacity Market Competitiveness and Reliability Outcomes*, November 2021.

[3] We recognize that not all CLCPA resource will necessarily offer into the capacity market at $0/kW-mo. However, this assumption in effect incorporates all CLCPA-driven capacity as inframarginal resources, which is an appropriate and conservative input to our capacity market model for the purpose of this analysis.

($/kW-mo) and clearing quantities in unforced capacity megawatts (UCAP MW) by year, season, and locality. The results in year one are provided for the baseline model set up, and the results for year five use baseline model assumptions for model year 2026.[4]

Table 1: Capacity Market Clearing Prices ($/kW-mo) by Capacity Locality and Season, 2022-2026

Capacity Locality	Summer		Winter	
	2022	**2026**	**2022**	**2026**
NYCA	$4.60	$5.07	$3.33	$4.23
G-J Locality	$7.46	$9.02	$3.87	$5.81
NYC (J)	$7.46	$12.83	$3.87	$7.51
LI (K)	$7.13	$14.61	$3.66	$12.05

Table 2: UCAP Clearing Quantities (MW) by Capacity Locality and Season, 2022-2026

Capacity Locality	Summer		Winter	
	2022	**2026**	**2022**	**2026**
NYCA	36,543	34,996	37,540	35,200
G-J Locality	13,791	12,376	14,268	12,868
NYC (J)	9,459	8,638	9,667	9,107
LI (K)	5,817	5,076	5,985	5,286

14. The combination of resource entry/exit (due to both exogenous and market economic factors) and proper accreditation of resources' contributions to reliability lead to outcomes at capacity market prices reasonably consistent with past market outcomes. The analysis also shows the capacity market would continue to generate competitive market outcomes and provide sufficient financial incentives both for the economic retention of resources needed for reliability and for the economic entry and exit of resources. This result is sustained in all seasons, zones and scenarios over the first five years (i.e., for both model years 2022 and 2026). Moreover, while market conditions and forecasts ten years out (2032) are necessarily more speculative, the results for various scenarios completed for that model year also demonstrate continued competitive market outcomes and the retention of sufficient resources to meet resource adequacy requirements.

[4] Our baseline results do not presume the presence of TDI transmission into NYC by the year 2026. However, we include a sensitivity that assumes TDI is in operation in year 2026.

IV. Analytic Method

15. Our analysis simulates the clearing of the NYISO capacity market in representative future years using a model of the NYISO spot capacity auction to approximate outcomes of the Installed Capacity market as a whole. The model separately represents the two sides of the capacity market - the supply curve and demand curve in each year, season, and capacity locality - and then applies NYISO's capacity market clearing logic to determine final clearing prices and quantities.

16. Modeled supply curves are based on resource quantities from NYISO's June 2020 Grid in Transition analysis ("GIT Evolution Study"), which analyzed the resource pathway required to meet the CLCPA's greenhouse gas (GHG) emission reduction requirements over the period 2020-2040.[5] The supply curves were developed using representative technology categories (e.g., combined cycle, steam turbine, gas turbine, wind, solar, etc.) for existing and new resources in each year, with the total installed capacity of each grouped technology category equal to the expected total quantity of resources in that class, by locality and year.

17. NYISO's spot auction clears on an unforced capacity (UCAP) basis, requiring that the installed capacity of each resource type be converted to UCAP quantities. We understand that NYISO is proposing to model the conversion of ICAP to UCAP (Capacity Accreditation) of all market resource types in each year on a going-forward basis. For the purpose of this analysis, we made the following assumptions about resource type's Capacity Accreditation.

18. First, we converted the installed capacity for existing non-intermittent, non-storage resources to UCAP values using NERC historical EFORd values. This is consistent with the rules for nonrenewables in current NYISO processes, and represents a reasonable approximation of forward-looking Capacity Accreditation for these resources for the purpose of this analysis.

[5] Brattle Group, "New York's Evolution to a Zero Emission Power System: Modeling Operations and Investment Through 2040 Including Alternative Scenarios," June 22, 2020 ("GIT Evolution Study").

19. Second, we needed to estimate the Capacity Accreditation for renewable and storage resources in order to translate these resources' installed capacity to UCAP values. For the purpose of clearing the capacity market on a going-forward basis, it is appropriate to credit resources' capacity on the basis of their marginal contribution to reliability in each capability year, and this is consistent with NYISO's proposal for Capacity Accreditation as part of the BSM Reforms. For our model it was important to develop specific estimates of marginal Capacity Accreditation for renewable and storage resources since (1) the marginal capacity value of these resources depends strongly on the quantity of these resources added to the system, and (2) the CLCPA will drive rapid growth in these resource types over the time period of our analysis. Thus, in our modeling of capacity market auctions the UCAP quantities for renewable and storage resources are based on estimates of their marginal Capacity Accreditation values as developed in the GIT Evolution Study. Section III.B of the Market Analysis Report provides additional detail about the development of marginal Capacity Accreditation values for renewable and storage resources.

20. Each resource type in the locational and seasonal supply curves is modeled with a separate offer price, with the method for calculation varied across resource types. CLCPA resources are assumed to offer in at $0/kW-mo and other resources are assumed to offer in at their expected going-forward costs (GFC), based on estimates of fixed and variable costs and market revenues from the GIT Evolution Study. Section III.B of the Market Analysis Report provides additional detail about the construction of the modeled supply curves.

21. The demand side of the NYISO spot capacity market is determined by the ICAP demand curves for each capacity locality, season, and year. We calculate ICAP demand curves in 2022, 2026, and 2032 for both summer and winter, based on assumptions of capacity requirements, demand curve shape, and cost of new entry for a representative peaking unit in each capacity locality. The ICAP demand curves are then translated into UCAP demand curves for the purposes of clearing the market against the UCAP supply curve in each capacity locality.

22. Demand curves are initially based upon parameters from the most recent NYISO Demand Curve Reset, and in future years are modified to reflect expected changes in levels of demand, costs of the reference technology, and ICAP/UCAP translation factors (which

change with the evolving resource mix). The capacity requirements are based on NYISO's 2021 Load & Capacity Data forecasts of future peak loads under its "CLCPA" load scenario, and assume installed reserve margins based on the portfolio average capacity values of the modeled system. Section III.C of the Market Analysis Report provides additional detail about the construction of the modeled demand curves.

23. The market clearing logic is consistent with NYISO capacity market clearing rules establishing modeled clearing prices and quantities as the intersection of the UCAP supply curves and UCAP demand curves in NYCA and each capacity locality. The NYISO capacity market model clears in multiple stages using the logic of nested capacity localities. In the first stage, the market model clears units within the smallest capacity localities, Zones J and K. Any segments of the supply curve that clear in Zone J also clear the market in the G-J Locality, and thus offer into the G-J Locality supply curve as zero-priced resources. In the second stage, the market model clears units within the G-J Locality. Any segments of the supply curve that clear in the G-J Locality (including Zone J), or Zone K, then offer into the NYCA supply curve as zero-priced resources. Finally, the model clears the NYCA supply and demand curves. The final clearing price in each capacity locality is the highest price for which capacity segments in that locality are eligible. Section III.D of the Market Analysis Report provides additional detail about the logic of the capacity market model.

V. Results - Baseline Case and Sensitivities

24. As noted earlier, we focus primarily on the first five years of market operation with BSM Reforms in place. Across this period of time, various resources are expected to exit or enter the market, and CLCPA resources will increase in importance in NYISO operations and market outcomes as they come into service. Over the initial five years of capacity market administration with the BSM Reforms in place, NYISO and stakeholders will gain experience with the revised market structure and implement supporting changes to market administration procedures (e.g., annual administration of marginal Capacity Accreditation modeling).

25. The results of the analysis in 2022 and 2026 for the New York Control Area as a whole, and for each of the NYISO capacity market localities are based on the penetration of resources described in Table 3 below. The results provide an indication of expected capacity market prices in dollars per kilowatt-month and clearing quantities in unforced capacity megawatts by year, season, and locality. The results in year one (2022) are provided for the baseline model set up, and the results for year five use baseline model assumptions for model year 2026.[6]

Table 3: NYCA Summer Capacity by Unit Type (MW)

Unit Type	2022		2026		2032	
	ICAP	UCAP	ICAP	UCAP	ICAP	UCAP
Fossil Fuel	26,315	24,322	23,481	21,833	23,485	21,836
Hydro	5,018	4,210	5,018	4,210	5,018	4,210
Nuclear	3,345	3,266	3,345	3,266	2,156	2,105
Onshore Wind	1,739	278	1,983	210	9,698	633
Offshore Wind	0	0	1,200	349	7,591	362
Utility-Scale Solar	56	26	5,056	942	16,669	702
Storage (2-hour)	592	258	2,156	816	4,264	1,266
Storage (4-hour)	2	2	9	7	386	229
Other Resources	2,671	2,541	2,571	2,450	3,251	3,109
SCRs	1,185	1,067	1,185	1,185	1,185	1,185
Net Imports	973	973	973	973	973	973
UDRs	1,042	1,042	1,042	1,042	1,042	1,042
Total	**42,939**	**37,985**	**48,021**	**37,283**	**75,719**	**37,653**

26. Results beyond year five are highly uncertain and speculative; given the pace of changes in New York State resource development driven by both policy and market outcomes beyond five years, and any additional changes in capacity, energy and ancillary services market designs. Nevertheless, we evaluate potential capacity market impacts out to year ten (2032) in order to assess at a high-level potential market outcomes further out in time. Table 4 and Table 5 contain the results of the baseline analysis in model year 2032 for the New York Control Area (NYCA) as a whole, and for each of the NYISO capacity market localities

[6] Our baseline results do not presume the presence of TDI transmission into NYC by the year 2026. However, we include a sensitivity that assumes TDI is in operation in year 2026.

Table 4: Capacity Market Clearing Prices ($/kW-mo) by Capacity Locality and Season, 2032

Capacity Locality	Summer 2032	Winter 2032
NYCA	$6.89	$6.28
G-J Locality	$9.58	$7.09
NYC (J)	$13.89	$10.93
LI (K)	$14.52	$13.18

Table 5: UCAP Clearing Quantities (MW) by Capacity Locality and Season, 2032

Capacity Locality	Summer 2032	Winter 2032
NYCA	35,607	36,234
G-J Locality	13,076	13,746
NYC (J)	8,792	9,345
LI (K)	5,429	5,676

27. In addition, we model the capacity market in 2026 and 2032 under three sets of sensitivities that represent potential changes to capacity market reference technologies and financial parameters, and expected changes to the transmission system.

28. First, we model the system with the addition of two large transmission projects planned in New York that, if or when completed, could change the geographic mix of resources needed to meet New York's overall resource adequacy requirements. These two projects are planned to be built by 2032 that were selected as part of the New York State Energy Research and Development Authority (NYSERDA) Tier 4 Renewable Energy Credit program: 1) Transmission Developer Inc. (TDI) is developing the 1,250 MW Champlain Hudson Power Express transmission line from Quebec into New York City, with a planned in-service date of 2025; and 2) Forward Power is developing the 1,300 MW Clean Path New York (CPNY) line from Zone E into New York City, with in-service date as early as 2027.

29. Second, a possible outcome of the current BSM reform proposal is to change the risk profile for new entrants into the NYISO electricity market. In particular, the cost of new entry (CONE) of a new generating resource depends on the immediate capital costs for constructing the unit, along with the financial parameters which determine the payback

period and return on investment for that unit. One of the key financial inputs is the Weighted Average Cost of Capital (WACC), which comprises the return on equity and cost of debt, along with the debt-to-equity (D/E) ratio used to finance the project. The market rule changes under the BSM Reforms could change the risks faced by developers in New York, and it has been argued in the ISO-NE context that a capacity market without a mitigation construct could raise financial risk as embodied in the WACC.[7] We therefore model a sensitivity where the WACC input into the NYISO demand curve includes an elevated risk premium.

30. Finally, advances in technology may change the fuel and technology type chosen by a marginal new entrant into the New York market in future years. In particular, advances in battery technology and decreases in costs may make battery energy storage systems (BESS) an economically viable option for consideration as the peaking technology in the Demand Curve Reset process. We model an alternate peaking technology sensitivity which assumes a 4-hour BESS as the peaking technology.

31. Results across all scenarios evaluated for year 2032 are consistent with the results found for the first five years of market implementation. Section III.E of the Market Analysis Report provides additional detail about the sensitivities modeled, and Section IV.B of the Report provides modeling results for these scenarios. Appendix A to the Market Analysis Report contains a comprehensive set of results for all cases, years, and localities.

VI. Observations and Conclusions

32. The results presented above represent a clearing of the NYISO capacity market subject to the BSM Reforms proposed by NYISO, and alongside a major transformation of the electric industry driven by the state's need to meet the obligations of the CLCPA. Specifically, changes underlying the results for 2026 include rapid alteration of the resources on the system compared to 2022.

[7] Potomac Economics, "Evaluation of Changes in the Minimum Offer Price Rules on Financial Risk," July 26, 2021, p.6, available at https://www.iso-ne.com/static-assets/documents/2021/07/a02b_potomac_economics_presentation_changes_in_mopr_on_financial_risk.pdf.

33. Based upon our analysis and the results presented above, we arrive at several observations associated with continued operation of the capacity market subject to the BSM Reforms proposed by NYISO.

34. First, the analysis reflects a rapidly changing system - many factors affect the modeling set up and results in each year, season, and locality. Exogenous factors lead to a significant amount of resource addition and attrition over the study period. In addition, it is clear that market dynamics lead to some retirement of resources based on market economics. The modeling period includes an unprecedented potential for changes in electricity demand, going-forward costs of existing units, cost of the demand curve reference technology, ICAP/UCAP translation factor, CLCPA resource growth, and transmission topology.

35. Second, despite these changes, with BSM reforms in place the NYISO capacity auction remains competitive. The combination of resource entry/exit - both due to exogenous and market economic factors - and proper accounting for resources' contributions to reliability using the marginal Capacity Accreditation method lead to capacity auction results consistent with competitive market outcomes.

36. Moreover, with BSM reforms in place the NYISO capacity auction outcomes continue to meet resource adequacy requirements. The analysis shows the capacity market can continue to generate competitive market outcomes, and provide sufficient financial incentives for the economic retention of resources needed for reliability, and for the economic entry and exit of resources. This result is sustained in all seasons, zones and scenarios over the first five years (i.e., for both model years 2022 and 2026).

37. Finally, the scenarios studied with a longer-term view (2032) and involving other factors - changes in transmission topology, changes in the reference technology, and possible changes in the financial parameters for new technology development - yield similar results. Specifically, the scenarios for 2032 also demonstrate continued competitive market outcomes and the retention through the capacity market construct of sufficient resources to meet resource adequacy requirements.

38. This concludes our affidavit.

Respectfully submitted,

/s/ Paul J. Hibbard
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