UNITED STATES OF AMERICA BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION

New York Public Service Commission)	Docket No.	EL15-64
_)		ER16-[]
V.)		
)		
New York Independent System Operator, Inc.)		

New York Independent System Operator, Inc.)

AFFIDAVIT OF JULIA N. POPOVA, PHD

Dr. Julia Popova declares:

I. Qualifications

- 1. I have personal knowledge of the facts and opinions herein and if called to testify could and would testify competently hereto.
- 2. I am the Economist of Market Mitigation and Analysis Installed Capacity for the New York Independent System Operator, Inc. ("NYISO"). My business address is 10 Krey Boulevard, Rensselaer, NY 12144.
- 3. I received a PhD in Economics from West Virginia University; a MA in Economics from the Center for Economic Research and Graduate Education - Economics Institute (a joint academic institution of Charles University and the Economics Institute of the Czech Academy of Sciences), Czech Republic; and an MS in Mathematics from Novosibirsk State University, Russia.
- 4. I received the International Association for Energy Economics' Energy Journal Campbell Watkins Best Paper Award, 2011. My publications regarding the energy market include "Storage and the Electricity Forward Premium," (with S.M. Douglas), Energy Economics, 2008; and "Econometric Estimation of Spatial Patterns in Electricity Prices," (with S.M. Douglas), Energy Journal, 2011.
- 5. I have been employed by the NYISO as an energy economist since 2008. I have been actively involved in the NYISO's administration of the market power mitigation rules and its market power analyses. My responsibilities have included assessing the competitive performance of the NYISO administered markets, including the Installed

Capacity¹ ("ICAP") market, as well as identifying and developing remedies for potential market design flaws and market power abuses.

- 6. Beginning in 2011 my work for the NYISO has focused on ICAP market power mitigation rules and capacity market power analyses. In particular, I have been actively involved in the administration, implementation and enforcement of the applicable ICAP market provisions of the Market Monitoring Plan,² administering the NYISO's capacity market power mitigation measures, conducting market power analyses, and reviewing market data to determine whether market performance is consistent with a competitive market.
- 7. My responsibilities have included performing determinations under the buyer-side capacity market power mitigation rules³ (the "BSM Rules"), calculating Going-Forward Costs, identifying and evaluating possible withholding, and implementing the monthly supply-side mitigation measures (*i.e.*, the Pivotal Supplier rules.)
- 8. Apart from capacity market power mitigation administration, I assist in the development of new, and revisions to the existing, market rules (including the ICAP Demand Curve reset.) I perform periodic reviews of capacity market outcomes. I am the subject matter expert responsible for preparing the NYISO's Annual Installed Capacity Report to the Commission on the NYISO's ICAP Demand Curves and potential withholding issues in Docket Nos. ER01-3001-000 and ER03-647-000. I have participated in the preparation of the past five such reports.
- 9. I have participated in the NYISO's development of revisions to existing and proposed new, capacity market mitigation measures, presentations to and discussions with stakeholders regarding the NYISO's proposals, and supported the NYISO's filings proposing the revisions.
- 10. I have participated in the NYISO's analysis of the buyer-side mitigation determination for the Hudson Transmission Partners, LLC project, and in the development of the scaling methodology used to estimate net Energy and Ancillary Services for that project. I also was extensively involved with the NYISO team that developed filings and responded to Commission orders in the proceedings concerning that determination. In addition, I was extensively involved in the development of the NYISO's tariff revisions proposed on compliance therein and I submitted a Confirming Affidavit to support the NYISO's recent *Further Compliance Filing* in Docket No. ER16-959-000.⁴

¹ Capitalized terms herein have the meaning set forth in the Compliance Filing including its Attachment A, and if not defined therein, the meaning set forth in the Market Administration and Control Area Services Tariff ("Services Tariff"), and if not defined therein, then as defined in the Open Access Transmission Tariff.

² The Market Monitoring Plan is Section 30, Attachment O, of the Services Tariff.

³ These rules are set forth in Section 23.4.5.7, *et seq*.

⁴ Hudson Transmission Partners, LLC v New York Independent System Operator, Inc., Docket No. EL12-98-001 and-002, Further Compliance Filing, Docket No. ER16-959-000 (February 17, 2016). The NYISO's proposed tariff revisions in that filing were accepted. See New York Independent System

11. As discussed below, I have also participated actively in the development of the April 13, 2016 compliance filing ("Compliance Filing") to which this Affidavit is attached. The NYISO is submitting the Compliance Filing in response to the Commission's October 9, 2015 order ("Order") in Docket No. EL15-64-000.⁵ In particular, I actively participated on the NYISO team that developed the Compliance Filing's proposed tariff revisions. I provided an overview of the NYISO analysis supporting the portion of the Compliance Filing discussed in this Affidavit to stakeholders at the January 26, 2016 meeting of the NYISO's Installed Capacity Working Group ("ICAP Working Group"). At the March 3, 2016 ICAP Working Group I presented a complete version of that analysis to stakeholders and led a discussion. I also discussed with stakeholders the Net Short Threshold and Net Long Threshold that are part of the Self Supply Exemption proposal, as well as draft tariff language. At the April 6, 2015 meeting of the ICAP Working Group I described the Net Short Test, and presented a numerical example of the manner in which it would be performed.

II. Issues Addressed by this Affidavit

- 12. This Affidavit explains and supports (in Section III) the NYISO's analysis of potential "Exempt Renewable Technologies," including its determination of which technology types should receive that classification as of the effective date of the proposed tariff revisions. This Affidavit also addresses the Excel Workbook ("Wind and Solar Analysis.xlsx"; the "Wind and Solar Analysis") of the NYISO which is submitted as Attachment IV to the Compliance Filing.
- 13. This Affidavit confirms that: (1) I reviewed the Order's guidance regarding the design of a Renewable Exemption; (2) I was the lead subject matter expert for the NYISO team conducting the Wind and Solar Analysis; (3) I have actively participated on the NYISO team that developed the Compliance Filing's proposed tariff revisions establishing that intermittent generators solely powered by wind or solar energy would be deemed to be Exempt Renewable Technologies; and (4) I was personally involved in the NYISO's development of the Compliance Filing's tariff provisions establishing the framework and guiding principles to be utilized in determining whether any and if so which Intermittent Power Resources and Run-of-River Hydro resources will be deemed to be Exempt Renewable Technologies in the future.
- 14. In Section IV, this Affidavit explains and supports the Compliance Filing's proposal to state in Installed Capacity ("ICAP") terms, and not in Unforced Capacity ("UCAP") terms, the 1,000 MW limit ("cap") on Renewable Exemptions for any given Class Year.

⁵ New York Public Services Commission, et al. New York Independent System Operator, Inc., 153 FERC ¶ 61,022 (2015)

Operator, Inc., Delegated Letter Order, Docket No. ER16-959-000 (Mar. 22, 2016) (accepting revisions to Services Tariff Section 23.4.5 and Section 30.4.6.2.12)

- 15. In Section V, this Affidavit further supports that the Compliance Filing's proposal on Renewable Exemptions is based on a sound principles, it is beneficial to the market, and it reasonably addresses the guidance provided by the Order.
- 16. Finally, this Affidavit confirms (in Section VI) that the Self Supply Exemption proposed in the Compliance Filing, including the proposed Net Short and Net Long Thresholds, is based on a sound design and reasonably addresses the guidance provided by the Order.

III. Exempt Renewable Technologies and the Wind and Solar Analysis

A. Overview

- 17. The Wind and Solar Analysis informed the NYISO's development of the new Renewable Exemption that is proposed in the Compliance Filing. It also informed the designation of Exempt Renewable Technologies, which are an element of the Renewable Exemption.
- 18. Specifically, the Order directed the NYISO to propose a Renewable Exemption that "should be limited to renewable resources that are both purely intermittent and that have relatively low capacity factors and high development costs because these resources have limited or no incentive and ability to artificially suppress capacity prices."⁶
- 19. The Compliance Filing is proposing that upon the effectiveness of the tariff revisions, Intermittent Power Resources solely powered by wind or solar energy would be deemed to be "Exempt Renewable Technologies."⁷ With that designation, any such projects that are proposed to be electrically located in a Mitigated Capacity Zone in the current Class Year (Class Year 2015,)⁸ or in future Class Years, and that request a Renewable Exemption would be eligible to obtain a Renewable Exemption from Offer Floor, mitigation without undergoing the case-specific economic test that would be applied to other Renewable Exemption Applicants that are powered by other technology types. The Wind and Solar Analysis provides the analytic basis supporting the designation of intermittent wind and solar Generators as Exempt Renewable Technologies.⁹
- 20. As discussed in the Compliance Filing, the proposed revisions also make clear that each Demand Curve Reset Filing Year (after the current reset year) the NYISO will be evaluating wind, solar, and other Intermittent Power Resources, and Limited Run-of-River Hydro to determine whether they should be Exempt Renewable Technologies.¹⁰ Thereafter, the NYISO would file with the Commission a report describing its analysis and conclusion, and any necessary tariff revisions to revise the designation of which

⁶ October Order at P 51.

⁷ See proposed Section 23.2.1 at proposed definition of "Exempt Renewable Technologies".

⁸ As the Compliance Filing identifies, there are no intermittent and renewable resources that are Examined Facility in Class Year 2015.

⁹ There are no projects solely powered by wind or solar energy in Class Year 2015 that are proposed to be located in a Mitigated Capacity Zone.

¹⁰ *See* proposed Section 23.4.5.7.13.2.

technologies are Exempt Renewable Technologies. The proposed process includes an opportunity for input from stakeholders and the Market Monitoring Unit. I believe that the NYISO's proposal to periodically review, and potentially update, what constitutes an Exempt Renewable Technology is appropriate and reasonable.

21. In my judgment, as a subject matter expert on capacity market power mitigation, the proposed tariff revisions establish a framework that will enable the NYISO to reasonably exempt (subject to the 1,000 MW cap) from the Offer Floor intermittent and renewable generating resources solely powered by either wind or solar energy; in addition to other qualified intermittent and renewable technologies, and Limited Run-of-River Hydro resources. The framework provides for the NYISO to determine whether a Renewable Exemption Applicant lacks both the ability and incentive to artificially suppress capacity market prices.

B. Examination of Technology Types for Designation as Exempt Renewable Technologies

- 22. As part of the Compliance Filing, the NYISO proposes that any Generator that is an Examined Facility or an NCZ Examined Project, and that is proposed as an Intermittent Power Resource) or Limited Control Run-of-River Hydro Resource, will be eligible to request a Renewable Exemption. At present, intermittent and renewable resources that solely depend on wind, solar energy, or landfill gas for their fuel, and Limited Control Run-of-River Hydro Resources, would be eligible to apply for the Renewable Exemption.
- 23. In addition, the NYISO proposes that those Examined Facilities and NCZ Examined Projects qualifying as an "Exempt Renewable Technology," as such term is defined on the Class Year Start Date, will be eligible for an exemption from the Offer Floor without the need for a unit-specific evaluation of whether they lack both the ability and incentive to artificially suppress capacity market prices. I believe that this provision will provide resources that have little or no ability to suppress capacity market prices additional certainty regarding their qualification for an exemption, while providing an adequate safeguard that they will not artificially suppress prices.
- 24. However, only those technology types that have been determined to have no incentive or ability to suppress market prices should be deemed to be Exempt Renewable Technology. Additional scrutiny of Examined Facilities and NCZ Examined Projects with other intermittent and renewable technology types is necessary in order to determine whether they meet those parameters.
- 25. In order to identify technologies that should be an Exempt Renewable Technology, the NYISO considered candidate intermittent renewable technologies that could qualify as either an Intermittent Power Resource or as a Limited Control Run of River Hydro Resource. The NYISO's consideration was further restricted to those that have (a) high developments costs, and (b) a low capacity factor, such that considering (a) and (b) there is limited or no incentive and ability to develop these technologies in order to artificially suppress capacity prices. Therefore, I believe that the relevant and recent project cost estimates used by the NYISO were necessary to making this determination.

26. The NYISO considered whether Intermittent Power Resources that solely depend on wind or solar energy should be designated as Exempt Renewable Technologies at this time.¹¹) There are already about 1,500 MW of ICAP powered by wind, and roughly 30 MW of ICAP provided by large scale resources powered by solar energy¹² currently participating in the NYISO Administered markets. There are also relevant studies available on project development costs, and the cost of new entry, for both wind and solar resources. For instance, the National Renewable Energy Laboratory publishes annual reports on the costs of utility scale wind and solar installations, including those within the NYCA.^{13,14} There are both large-scale solar and wind projects proposed in the NYISO Interconnections Queue¹⁵.And last, but not least, there are New York State funded programs to support and promote development and use of clean energy technologies (see NYSERDA, for instance¹⁶) powered by wind and solar. This indicates that, although at present time, development and operation of these technologies present unique and complex financial and technical challenges, there is growing interest in employing wind and solar in order to increase load flexibility, reduce greenhouse gases emission, and provide additional efficiency and reliability to the electricity system. These observations, taken together, provided a sufficient basis of information, and data, for the NYISO to perform an in-depth analysis to determine whether or not these technologies should be deemed to be Exempt Renewable Technologies.

¹³ 2014 Cost of Wind Energy Review, available at http://www.nrel.gov/docs/fy16osti/64281.pdf

2014 Wind Technology Market Report https://emp.lbl.gov/sites/all/files/lbnl-188167.pdf

¹⁴ Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections 2015 Edition report, available at http://www.nrel.gov/docs/fy15osti/64898.pdf

Utility-Scale Solar 2014: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States https://emp.lbl.gov/sites/all/files/lbnl-1000917.pdf

¹⁵ The NYISO Interconnection Queue dated 3/31/2016: http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources /Interconnection_Studies/NYISO_Interconnection_Queue/NYISO%20Interconnection%20Queue.xls

NY-Sun for Commercial/Industrial developers program description can be found at: http://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Megawatt-Block-Dashboards/CI-Dashboard

Large Wind Farm Developments program description is available at: http://www.nyserda.ny.gov/Cleantech-and-Innovation/Power-Generation/Wind/Large-Wind

Renewable Portfolio Standard Main Tier program (established by PSC orders issued for Case 03-E-0188), administered by NYSERDA, is available at http://www.nyserda.ny.gov/All-Programs/Programs/Main-Tier

¹¹ See "Wind and Solar Analysis" and Compliance Filing Section III.C and Section III.D.

¹² See 2015 Load and Capacity Data ("2015 Gold Book"), available at: <http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resource s/Planning_Data_and_Reference_Docs/Data_and_Reference_Docs/2015%20Load%20and%20Capacity% 20Data%20Report.pdf>.

- 27. The NYISO also considered whether Intermittent Power Resources and Limited Control Run-of-River Hydro Resources, other than intermittent wind and solar resources, and that were technically feasible in ISO-Administered Markets, should be Exempt Renewable Technologies as of the effective date of the proposed compliance tariff revisions.
- 28. Specifically, the NYISO investigated whether Limited Control Run-of-River Hydro Resources should be included as an Exempt Renewable Technology. First, there are no proposed new hydroelectric generators in the NYISO's Interconnection Queue for either of the Mitigated Capacity Zones, and only a small number of MW of conventional hydroelectric generating stations proposed to be built in the Rest of State. Based on the examination conducted for purposes of the analysis, it is not clear whether any of those proposed Generators could be Limited Control Run-of-River Hydro resources. Second, the total capability of conventional hydroelectric resources in the NYCA decreased between 2005 and 2015.¹⁷ Third, while there are some available studies on the costs to develop new hydroelectric projects,¹⁸ much of this data is older and limited, in the United States, to generalized information on construction and development costs. I am not aware of any available studies that contain specific information for the NYCA.
- 29. The data that is available indicates that, although the technology is mature, the total investment costs for hydroelectric generators (including run-of-river hydro) vary significantly, and are heavily dependent on project details, such as the site and engineering design. As a result, the NYISO concluded that, given the variations in NYCA-specific Limited Control Run-of-River Hydro Resource project characteristics, including in site and engineering design, and therefore the cost of new entry, there was an insufficient basis to justify performing an in-depth analysis for Limited Control Run-of-River Hydro Resources, and that the definition of "Exempt Renewable Technologies" should not include them at this time.
- 30. The NYISO also examined whether landfill gas resources should be included as an Exempt Renewable Technology. Although, there are about 100 MW of landfill gas Installed Capacity resources in the NYCA, only about 10 MW of Installed Capacity have entered the market since 2010,¹⁹ and none are located in a Mitigated Capacity Zone. It appears that, similar to hydroelectric generation, the cost of landfill gas projects depend on a number of project-specific factors, including the size, geographical location, and layout of the landfill.²⁰ Currently, there are no such projects in the NYISO's

²⁰ See chapter 4 of LFG Energy Project Development Handbook available at https://www3.epa.gov/lmop/publications-tools/handbook.html

Fact Sheet: Landfill Methane Report available at : http://www.eesi.org/papers/view/fact-sheet-landfill-methane>

¹⁷ See 2015 Gold Book

¹⁸ http://www.iea.org/publications/freepublications/publication/hydropower_essentials.pdf

 $http://www.irena.org/documentdownloads/publications/re_technologies_cost_analysis-hydropower.pdf$

¹⁹ See 2015 Gold Book

Interconnection Queue in Mitigated Capacity Zones. Finally, it has been observed that landfill gas resources may be able to achieve fuel reliability of over 90% in some circumstances, ²¹ which would arguably not allow them to be categorized as having a low capacity factor. Thus, the NYISO concluded that there was an insufficient basis to justify performing an in-depth analysis for landfill gas resources, and that the definition of "Exempt Renewable Technologies" should not include them at this time.

- 31. Therefore, and considering all of the above, the NYISO determined that there were no technologies except wind and solar that merited an in-depth analysis to determine whether or not they should be designated as Exempt Renewable Technologies at this time. These and other technically feasible types of renewable and intermittent resources may be studied for the Exempt Renewable Technology status during the next Demand Curve Reset Year. I agree with the NYISO's determination and believe it to be reasonable.
- 32. Under the NYISO's proposal, Limited Control Run-of-River Hydro Resources and landfill gas resources that are Examined Facilities or NCZ Examined Projects can still request a Renewable Exemption. Their eligibility for a Renewable Exemption will be based on an evaluation of the project-specific development costs, and other factors.

C. Scope of Wind and Solar Analysis

- 33. The Wind and Solar Analysis sought to determine, for each Mitigated Capacity Zone, whether intermittent generation technologies solely powered by wind and solar energy have (a) high developments costs and (b) low capacity factors, such that considering (a) and (b) there would be limited or no incentive or ability to develop them to artificially suppress capacity prices. Thus, the Wind and Solar Analysis examined the extent to which economic benefits of market price suppression strategies existed and whether such benefits were likely to outweigh the costs of pursuing such strategies using wind and solar resources. In short, if the net present value of all revenues, benefits, and cost savings to the load due to capacity price decreases were less than zero, then it could be concluded that an Intermittent Power Resource solely powered by wind or solar energy would not have the incentive or the ability to suppress capacity prices for the benefit of capacity buyers.
- 34. The NYISO analyzed new hypothetical intermittent renewable resources: *i.e.*, offshore wind, inland wind, and solar, that might practicably be expected to locate in the current Mitigated Capacity Zones. Those are the G-J Locality (comprised of Load Zones G, H, I, and J) and Load Zone J. The NYISO's analysis did not find, and stakeholder discussions did not reveal, any evidence of realistic financial incentives for such resources to be

²¹ See 2015 Gold Book 2015 Table III-2 "Existing Generating Facilities", for NYCA landfill gas resources' production factor was reported between 25% and 95% based on 2014 net energy data.

Costs and Financing Costs and Revenues from LFG Collection and Energy Production

at http://www.eesi.org/papers/view/fact-sheet-landfill-methane#3

developed to engage, or be used in, in capacity price suppression efforts in the Mitigated Capacity Zones.

D. The Lack of Incentive or Ability for Intermittent Wind and Solar Resources to Suppress Capacity Market Prices

- 35. The NYISO examined whether intermittent wind and solar energy resources have the incentive and ability to suppress prices in Mitigated Capacity Zones by calculating the net-present value ("NPV") of a number of hypothetical new intermittent renewable resources. The analysis accounted for likely projected revenues based on the sale of Capacity, Energy and Ancillary Services; estimated maintenance and operating costs; generally available revenues associated with the production of energy, such as the United States Internal Revenue Service Production Tax Credit and the Investment Tax Credit, and renewable energy credits; and the estimated cost of new entry, including developing, financing, constructing, and bringing the new facility into service. In addition, the calculation estimated net present value of after-tax cost savings from capacity market price suppressing effects to capacity buyers (Load).
- 36. As noted above, the NPV calculations were performed for hypothetical inland wind, and solar stations in Load Zones G, H, I, and J, and offshore wind for Load Zone J, of a size that would reasonably be expected to be technically feasible in the ISO Administered markets. These technologies are intermittent²² due to fuel variability that is difficult to predict and that is beyond the control of the facility owner or operator. They are also "renewable" in nature since the energy sources are constantly being replenished.
- 37. In general, subsidies²³ and incentives²⁴ for renewable and intermittent technologies are designed to mitigate high investment risks and provide production incentives to

FERC Order 764

²³ Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013 March 2015 (table ES4) available at http://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf

NYSERDA Main Tier Solicitations program is available at http://www.nyserda.ny.gov/All-Programs/Programs/Main-Tier/Main-Tier-Solicitations

²² See Services Tariff Section 2.9 at definition of Intermittent Power Resource; see also New York Independent System Operator, Inc., 146 FERC ¶61,208 at P 32 (2014) (accepting current version of the NYISO's definition of "Intermittent Power Resource" as a substitute for the "Variable Energy Resource" terminology the NYISO would otherwise have been required to adopt under Order No. 764.) See also Integration of Variable Energy Resources, Order No. 764, FERC Stats. & Regs. ¶ 31,331, order on reh'g, Order No. 764-A, 141 FERC ¶ 61,232 (2012), order on reh'g, Order No. 764-B, 144 FERC ¶ 61,222 (2013).

NY-Sun Annual Performance Report through December 31, 2015 can be found at http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={FC00899C-3B27-475E-A335-0055403967CB}

accelerate the development of renewable technologies. As a general matter, subsidies and incentive continue until such technologies become sufficiently mature for developers to fully capture, and be supported by, market profits (*i.e.*, become fully competitive with the technologies already employed to produce electricity and that are already considered technically feasible and sustainable.^{25,26})

38. There are ample publically available studies and reports that contain projected estimates for the cost of new entry of solar and wind projects²⁷ that either have been or are being

New York State Renewable Portfolio Standard 2015 Annual Performance Report can be found at http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={B0D5A493-111B-4A07-97E9-8E39A4BE2455}

²⁴ For example, production tax credit ("PTC") was enacted in 1992 and has been renewed and expanded numerous times. For further details see the *American Recovery and Reinvestment Act of* 2009 (H.R. 1 Div. B, Section 1101 & 1102) issued in February 2009, the *American Taxpayer Relief Act of* 2012 (H.R. 8, Sec. 407) issued in January 2013, the *Tax Increase Prevention Act of* 2014 (H.R. 5771, Sec. 155) issued in December 2014, and the *Consolidated Appropriations Act,* 2016 (H.R. 2029, Sec. 301) issued in December 2015.

²⁵ Offshore Wind Cost Reduction Pathways Study commissioned by The Crown Estate, available at: http://www.thecrownestate.co.uk/media/5493/ei-offshore-wind-cost-reduction-pathways-study.pdf

New York Offshore Wind Cost Reduction Study by NESERDA https://www.ceoe.udel.edu/File%20Library/About/SIOW/New-York-Offshore-Wind-Cost-Reduction-Study-ff8-2.pdf.

The U.S. Department of Energy's Wind Program available at

http://energy.gov/eere/wind/offshore-wind-research-and-development

A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States available at http://energy.gov/sites/prod/files/2013/12/f5/national_offshore_wind_strategy.pdf

2014 -2015 Offshore Wind Technologies Market Report available at http://www.nrel.gov/docs/fy15osti/64283.pdf

²⁶ Installation, Operation and Maintenance Strategies to Reduce the Cost of Offshore Wind Energy, a technical report of NREL(in joint authorship with the Energy Research Centre of the Netherlands) available at http://www.nrel.gov/docs/fy13osti/57403.pdf

²⁷ 2014 Cost of Wind Energy Review, available at http://www.nrel.gov/docs/fy16osti/64281.pdf

2014 Wind Technology Market Report https://emp.lbl.gov/sites/all/files/lbnl-188167.pdf

Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections 2015 Edition report available at http://www.nrel.gov/docs/fy15osti/64898.pdf

Navigant 2014 Report on Offshore Wind Market and Economic Analysis http://energy.gov/eere/downloads/2014-offshore-wind-market-and-economic-analysis

Utility-Scale Solar 2014: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States https://emp.lbl.gov/sites/all/files/lbnl-1000917.pdf

DOE 2014 wind technologies market report http://energy.gov/sites/prod/files/2015/08/f25/2014-Wind-Technologies-Market-Report-8.7.pdf

developed in the United States, aggregated by geographical location. The cost of new entry for hypothetical wind or solar projects in Mitigated Capacity Zones was assumed to vary both with geographical location and technology. The cost of new entry for offshore wind electrically located in Load Zone J was assumed to be \$5,500/kW, inland wind built in Load Zone J was estimated to cost \$2,700/kW, while wind built anywhere in Load Zones G, H, or I would likely cost \$2,250/kW. Solar projects interconnected in Zone J were estimated to cost \$4,500/kW, and in Load Zones G, H, and I to cost \$3,750/kW.

- 39. The estimated cost of new entry for hypothetical solar and wind investments in Load Zones G, H, I, and J does not include interconnection, System Upgrade Facilities ("SUF"), or System Deliverability Upgrades ("SDU") costs. These costs vary from project to project and are location specific. Importantly, including these costs would increase costs of new entry/cost to build and, thus, decrease the NPV of a project. Therefore, assuming these costs to be zero in the NYISO's analysis was a conservative assumption that tended to overstate the incentive of renewable resources to suppress prices.
- 40. In the NYISO's analysis, a financing structure was assumed for the hypothetical subsidized wind and solar entrants based on that of a regulated transmission and distribution utility in Load Zones G, H, I and J. Because actual projects continue to demonstrate that absent subsidies they would not recover their investment solely from market-based revenues, for purposes of the NYISO's analysis it was reasonable to assume that if an entity was to build a wind or solar generator, its financing would either be supported by a contract with a Load Serving Entity ("LSE") or governmental entity. Therefore, the financing structure would more closely resemble that of an LSE rather than that of a competitive entrant.
- 41. The debt to equity ratio used for the analysis was an average of the ratios of the regulated distribution utilities serving Load in Load Zones G, H, I and J. Debt to equity ratio was therefore set to 50%/50%. The nominal return on equity ("ROE") was set at 8.93%, which is reflective of the allowed ROE established by the New York State Public Service Commission ("NYPSC") orders for regulated distribution utilities.²⁸ The nominal debt

Revolution...Now The Future Arrives for Five Clean Energy Technologies – 2015 Update http://energy.gov/sites/prod/files/2015/11/f27/Revolution-Now-11132015.pdf

DOE Assumptions to the Annual Energy Outlook 2015

https://www.eia.gov/forecasts/aeo/assumptions/pdf/electricity.pdf

DEO 2013 Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants http://www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf

²⁸ See, e.g., Annual Reports on NYS Regulated Utilities can be found at http://www3.dps.ny.gov/W/PSCWeb.nsf/0/A97C16D00017FB1F852578E0005454E8?OpenDocument

More specifically, the following reports were used: http://www.oru.com/documents/financialreports/2015YearEnd.pdf

http://www.chenergygroup.com/financialinformation/CHEnergyGroup_2014_Q4.pdf

http://www.coned.com/documents/Con_Edison_2014_Annual_Report.pdf

rate was set to 5.37%, which is reflective of average current long-term debt interest payments as found in Annual Financial Reports filed with the NYPSC.

- 42. Both ROE and debt rate were reported in nominal terms, since inflation was accounted for elsewhere in calculations through the use of an escalation factor. Inputs used for the inflation rate were the same as those which were accepted by the Commission when it accepted the currently effective ICAP Demand Curves.²⁹ The discount factor used was the nominal ROE, as it more properly reflected the lost opportunity cost of the equity share used for investment.
- 43. The values used for the tax depreciation period and debt period/investment horizon were industry standards that are routinely allowed by the Internal Revenue Service for each type of investment.³⁰ A five year MACRS schedule was assumed for solar and on-shore wind, while a ten year MACRS schedule was assumed for offshore wind project.
- 44. Assumed energy market prices were based on the historic 5-year average of past Real-Time Prices in Load Zones G, H, I, and J, *i.e.*, they were respectively \$45/MWh, \$50/MWh for hypothetical on-shore and offshore wind units; and \$65/MWh, \$70/MWh for a hypothetical solar unit based on daylight hours, *i.e.*, HB06 through HB20.
- 45. It is common for wind and solar projects to have executed power purchase agreements ("PPAs").³¹ In a competitive pricing environment where the PPA price is sufficient to recover initial capital costs, cover ongoing operating costs, and provide a near-market rate of return, PPA prices will represent the minimum amount of revenue required by a project. In general, high development cost and low capacity factor resources will require higher prices in order to be economically viable, however, on average levelized wind and solar PPA prices are reported to be near-competitive with the wholesale power prices.³²

³⁰ See, https://www.irs.gov/publications/p946/ch04.html

³¹ See, e.g., 2014 -2015 Offshore Wind Technologies Market Report available at < http://www.nrel.gov/docs/fy15osti/64283.pdf>

Financing U.S. Renewable Energy Projects Through Public Capital Vehicles: Qualitative and Quantitative Benefits_http://www.nrel.gov/docs/fy13osti/58315.pdf

Utility-Scale Solar 2014: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States https://emp.lbl.gov/sites/all/files/lbnl-1000917.pdf

2014 Wind Technologies Market Report http://energy.gov/sites/prod/files/2015/08/f25/2014-Wind-Technologies-Market-Report-8.7.pdf

U.S. Wind Industry Fourth Quarter 2015 Market Report http://www.awea.org/Resources/Content.aspx?ItemNumber=8319

³² Wind Energy Cost, Performance and Pricing Trends: Past & Future (2013) http://www.cesa.org/assets/Uploads/Wiser-2013-RPS-Summit-Presentation.pdf

 $^{^{29}}$ See New York Indep. Sys. Operator, Inc., 146 FERC \P 61,043 (2014); order on reh'g, 147 FERC \P 61,148 (2014).

- 46. ICAP annual prices were assumed to be \$128.7/kW-year in NYC and \$74.1/kW-year in the G-J Locality. Those values were adjusted for inflation and technological progress in future years. These price levels are based on the most recent ICAP Spot Market Auction Capacity Market-Clearing Prices and Monthly Auction Market-Clearing Prices available at the time the analysis was performed (*i.e.*, as of January 2016.) The use of a simplistic assumption regarding forecasted Energy market and ICAP revenues was both reasonable and desirable, in that it retained the focus of the analysis on whether solar/wind technologies have limited to no incentives and ability to suppress capacity market prices.
- 47. Assumptions for capacity and energy market derating factors were made based on the values in the Installed Capacity Manual for new wind units and new solar units,³³ and the values in publically available studies and reports³⁴, as well as the 2015 Gold Book.³⁵ Both capacity and energy market derating factors for offshore wind were assumed to be 40%; for on-shore wind derating factors were assumed to be 20% for capacity and 30% for energy; and for utility-scale solar they were assumed to be 25% for capacity and 20% for energy.
- 48. The levels of assumed derating factors were low since conventional generating units that burn fossil fuels may be made available to dispatch almost 100% of the time, subject to mechanical and physical failures of the machine. Conventional generating units are not always economic to be dispatched, and as a result, they may have a low production factor due to higher cost of fossil fuel that may not be covered by the prevailing market prices. Unlike conventional generators that use fossil fuels to produce energy, the fuel for wind and solar resources is nearly "free" and non-depletable. However, the availability of fuels like wind and solar energy is beyond the control of facility owners or operators neither wind, nor light can be purchased from the market at any price and neither can it be reasonably stored for future use.³⁶ Thus, they are intermittent. Therefore, the derating factors of generating units powered by these fuels are generally significantly higher than the derating factors of conventional generating units that burn fossil fuels. If the fossil

2014 Wind Technologies Market Report http://energy.gov/sites/prod/files/2015/08/f25/2014-Wind-Technologies-Market-Report-8.7.pdf

Utility-Scale Solar 2014: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States https://emp.lbl.gov/sites/all/files/lbnl-1000917.pdf

³³ See Installed Capacity Manual Section 4.5, available at: <http://www.nyiso.com/public/webdocs/markets_operations/documents/Manuals_and_Guides/Manuals/O perations/icap_mnl.pdf>. The Installed Capacity Manual does not have a derating factor for off-shore wind.

³⁴ See, Utility-Scale Solar 2014: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States https://emp.lbl.gov/sites/all/files/lbnl-1000917.pdf

2014 Wind Technologies Market Report < http://energy.gov/sites/prod/files/2015/08/f25/2014-Wind-Technologies-Market-Report-8.7.pdf>

³⁵ See 2015 Gold Book 2015

³⁶ The definition of Intermittent Power Resource requires that "cannot be stored by the facility owner or operator." *See* Services Tariff Section 2.9 at definition of Intermittent Power Resource.

fuels were near free as are wind and solar light, the derating factors of the units powered by fossil fuels would likely be close to 100%. Considering these observations, I believe that the order of magnitude of 40% for derating factors for solar and wind generators is "low."

- 49. Energy market derating factors were used to project the energy revenues a hypothetical unit might receive by multiplying derating factors and the annual projected energy price (which is product of the energy markets price, the number of hours in the year, and the assumed MW size of a project.) In order to estimate the capacity market revenue, capacity market derating factors were multiplied the by number of hours in the year, the assumed MW size of a project, and adjusted for the effect on the project's entry on ICAP Market-Clearing Prices.
- 50. Total annual fixed operations and maintenance expenses were set at one to two percent of the initial capital investment. This estimate was based on estimated and observed fixed operations and maintenance expenses for recent wind and solar projects.³⁷ These costs do not cover property taxes, insurance, and site land leasing costs, all of which would be case-specific, calculated separately, and were not included in this analysis. As noted above with respect to interconnection, SDU, and SUF costs, including these costs would increase the estimated costs of new entry and, therefore, decrease the expected NPV of a project. A project with limited or no incentive and ability to artificially suppress capacity prices, for which these costs were not zero, would have even less incentive and ability to artificially suppress capacity prices. Costs attributable to Payment in Lieu of Taxes ("PILOT") agreements were assumed to be zero, although generation projects commonly enter into PILOT agreements with local taxing authorities. PILOT agreements would generally offset real property taxes, and such taxes were not included in this analysis. Therefore, the affect of PILOT agreements on costs would not reasonably be expected to change any conclusions drawn from the analysis.
- 51. The NYISO analysis also assumes wind and solar projects receive several subsidies that are generally available to them. Revenues like renewable energy credits³⁸ at \$25/MWh for both solar and wind and as part of federal programs to encourage renewable generation Production Tax Credits for wind³⁹ at \$23/MWh; and Investment Tax Credits

³⁷ See http://www.eia.gov/forecasts/aeo/assumptions/pdf/table_8.2.pdf

http://www.nrel.gov/analysis/tech_lcoe_re_cost_est.html

³⁸ Renewable energy certificate (REC) products available to retail customers nationally or regionally, for instance see http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=1

NYSERDA 2015 RPS Performance Report (p 6) available http://www.nyserda.ny.gov/All-Programs/Programs/Main-Tier/Documents

³⁹ http://nawindpower.com/congress-passes-omnibus-bill-with-five-year-wind-ptc-extension

http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=8254

http://www.irs.gov/pub/irs-pdf/f8835.pdf

for Solar at 30% of initial investment⁴⁰ were reflected in the analysis to offset the costs of developing and operating the hypothetical units.

52. The NPV of each of the renewable resources in each Mitigated Capacity Zone was calculated as the discounted after-tax net cash flows the project was expected to generate. The calculations of cash flows reflect assumptions on return on equity (discount factor,) amortization periods, inflation rate, tax depreciation schedules, and composite tax rate assumptions (including as appropriate federal, state, and New York City tax rates.) The assumptions can be seen in the Wind and Solar Analysis (Attachment IV).

E. Wind and Solar Analysis Estimation of LSE Cost Savings Associated with Reduced Capacity Prices

- 53. If the projected costs of new entry for a hypothetical new entrant wind or solar resource are higher than the sum of likely projected revenues and the sum of capacity price suppression benefits then it is reasonable to conclude that the resource has limited or no incentive or ability to suppress capacity market prices.
- 54. The immediate price impact of additional capacity in Mitigated Capacity Zones was calculated based on the slopes of the 2015/2016 NYCA ICAP Demand Curves. This reduction in price is estimated to reduce the cost of procuring of additional 100MW of UCAP by about \$48.7M/year in Rest of State, about \$145M/year in New York City; about \$33.1M/year in Load Zones GHI, across all LSEs. The NYISO calculated these values as the product of the reduction in the Market-Clearing Price of the ICAP Spot Market Auction and the amount of UCAP electrically located in a given Mitigated Capacity Zone. This calculation takes into account that additional capacity would have to be purchased as well.

F. Wind and Solar Analysis: Conclusions, Recommendations, and Confirmations

RULES COMMITTEE PRINT 114-39 TEXT OF HOUSE AMENDMENT #1 TO THE SENATE AMENDMENT TO H.R. 2029, MILITARY CONSTRUCTION AND VETERANS AFFAIRS AND RELATED AGENCIES APPROPRIATIONS ACT, 2016 available at: <http://docs.house.gov/billsthisweek/20151214/CPRT-114-HPRT-RU00-SAHR2029-AMNT1final.pdf>.

⁴⁰ Public Welfare Investments in Solar Energy Facilities Using Renewable Energy Investment Tax Credit http://www.occ.gov/topics/community-affairs/publications/fact-sheets/fact-sheet-solar-energyinvest-tax-credits-grants.pdf

The Energy Improvement and Extension Act of 2008 extended the authorization for the energy ITC for solar property. A tax credit investor may use the energy ITC if a solar energy property is placed in service before January 1, 2017 (See 26 USC 48(a)(3)(A)(i and ii), 26 USC 48(a)(2)(A), 26 USC 48(a)(2)(A)(i)(II)).

- 55. The NYISO calculated the NPV of the estimated cost of new entry (including developing, financing, constructing, and bringing the new facility into service), the likely projected revenues, and benefits a wind or solar resource may have received. Even considering the cost savings from lower capacity prices to the load throughout the NYCA, due to entry of such generating resources, all of the NPVs were significantly less than zero; suggesting that subsidizing new entry powered by wind or solar would not be a sound financial strategy to suppress capacity prices to benefit capacity buyers.
- 56. The NYISO's analysis, demonstrate that generators solely powered by wind or solar would have (a) high developments costs and (b) a low capacity factor, such that considering (a) and (b) there is limited or no incentive and ability to develop the candidate intermittent renewable technology to artificially suppress capacity price.
- 57. Thus, in my opinion as a subject matter expert in capacity market power analysis and capacity market power mitigation design, the Wind and Solar Analysis demonstrates that it is reasonable for projects solely powered by wind or solar energy to be Exempt Renewable Technologies upon the effectiveness of the tariff revisions. Such projects appear to have limited or no incentive or ability to suppress capacity prices. They should therefore be exempt from Offer Floor mitigation (subject to the 1,000 MW cap per Class Year discussed in the Compliance Filing and confirmed in the Confirming Affidavit of Nicole Bouchez, PhD).
- 58. I reiterate that my work and work performed under my direction forms the basis of the NYISO determination that Intermittent Power Resources solely powered by wind or solar energy should be Exempt Renewable Technologies in all Mitigated Capacity Zones.
- 59. I also confirm that all of the statements and facts set forth in the Wind and Solar Analysis are true and correct to the best of my knowledge and understanding.
- 60. I reiterate that I was personally involved with and was the lead subject matter expert for the team that conducted the analyses described in the Wind and Solar Analysis, including those that required the exercise of expert judgment, and fully support the descriptions of the analyses contained therein.

IV. Stating the 1,000 MW Cap on Renewable Exemptions in a Class Year in ICAP Terms

61. The Compliance Filing and the Bouchez Affidavit describe the 1,000 MW cap for the Renewable Exemption. This section of my affidavit will describe the bases for establishing that cap based on ICAP rather than UCAP. The NYISO is proposing to establish an ICAP based cap primarily because it (a) provides for a stable and transparent quantity each exempt Renewable Resource will be allowed to offer into the ICAP Market, (b) ensures consistency between the assumptions employed in the Renewable Exemption test and the actual market outcome, and (c) is simple in design and to administer.

- 62. An ICAP based cap will provide potential developers, LSEs, and other Market Participants with reliable and transparent information. Because the NYISO's proposal provides for it to post on its web site a list of the Examined Facilities and NCZ Examined Projects that request a Renewable Exemption (*i.e.*, Renewable Exemption Applicants,) at a relatively early stage in the Class Year process, stakeholders will be well positioned to evaluate for their own purposes whether the 1,000 MW cap will be exceeded in a given Class Year, and to consider the implications.
- 63. An ICAP based cap also would treat different technologies equally when the cap is triggered. For example, if the cap was based on UCAP and it was exceeded, and if two projects had the same CRIS MW, because derating factors differ between technologies and, in some cases, individual projects, then one Renewable Exemption Applicant might obtain a greater share of the cap; *i.e.*, it would have more exempt CRIS MW than the other. An ICAP based cap, by contrast, does not favor one technology over another in such a manner.
- 64. An ICAP based cap would retain consistency between the Renewable Exemption and other BSM exemptions. Under all of the other BSM Rules, it is a project's CRIS MW, which is in ICAP terms that are determined to be either exempt or not exempt. The NYISO's proposal would have the Renewable Exemption operate in the same manner.
- 65. ICAP is a stable quantity that does not vary in its meaning either seasonally or year-overyear. In contrast, UCAP changes seasonally and is calculated for each Resource using its derating factor. The very conversion between ICAP and UCAP, *i.e.*, the physical capacity corresponding to a MW of UCAP, varies both season-to-season and by Locality with the system weighted average derating factor calculated for that period. As a result, a UCAP based cap will necessarily vary in meaning over time, and between Localities. The 'size' (*i.e.*, the amount of physical capacity or CRIS MW corresponding to it) of a UCAP based cap will likely be different from one Class Year to another.
- 66. Furthermore, in order to implement a UCAP based cap, the NYISO would have to track every resource with a Renewable Exemption, by Class Year, and recalculate their available UCAP each Capability Period in order to determine whether or not the cap was binding. This implementation represents a significant increase in complexity and administrative burden as compared with an ICAP based cap. An alternative implementation for a UCAP based cap, which would avoid much of this additional complexity, would be to determine and allocate the UCAP MW available under the cap to the Examined Facilities and NCZ Examined Projects only once, at the conclusion of the class year. This approach would determine the allocation between projects of exempt MW on a UCAP basis, but would then convert it to ICAP, using whatever information about derating factors available at that time, and provide exemption determinations on a

CRIS MW basis. However, this approach would be largely equivalent to an ICAP based cap, without retaining its simplicity and transparency.

- 67. Likewise, the implementation of a UCAP based cap would introduce additional uncertainty for resources seeking, and having already been granted, a renewable exemption. Because the NYISO would have to determine whether the cap is exceeded each time resources' derating factors were updated, even an already exempt renewable resource will not know with certainty whether some of its UCAP will be subject to the Offer Floor for any given Capability Period. In contrast, if the cap were in ICAP, every ICAP Supplier that has received a Renewable Exemption will know if any of its CRIS MW are subject to the Offer Floor, and will therefore be able to accurately predict its exempt UCAP with the same certainty as with which it can predict its available UCAP. Thus, it would be in the same position as other resources that are subject to an Offer Floor.
- 68. For all of these reasons, I concur with the NYISO's recommendation to establish the cap for Renewable Exemptions in terms of ICAP. I believe such a cap is just and reasonable, and is furthermore preferable to a cap established in terms of UCAP.

V. Renewable Exemption: Additional Recommendations, and Confirmations

- 69. It is also my opinion that there is no basis for deeming other kinds of resources to be Exempt Renewable Technologies at this time. It may be, however, that different technologies will be shown to be warranted to be Exempt Renewable Technologies at the time of the NYISO's periodic review in a future ICAP Demand Curve Reset Year. I also note that intermittent renewable resources not included from the proposed definition of "Exempt Renewable Technology" would still be eligible for a Renewable Exemption if they pass the case-specific economic test discussed in the Compliance Filing.
- 70. I reiterate that my work and work performed under my direction forms the basis of the NYISO determination that Intermittent Power Resources solely powered by wind or solar energy should be Exempt Renewable Technologies in all Mitigated Capacity Zones.
- 71. I also confirm that all of the statements and facts set forth in the Wind and Solar Analysis are true and correct to the best of my knowledge and understanding.
- 72. I reiterate that I was personally involved with and was the lead subject matter expert for the team that conducted the analyses described in the Wind and Solar Analysis, including those that required the exercise of expert judgment, and fully support the descriptions of the analyses contained therein.
- 73. Finally, I also believe that the Compliance Filing's proposed tariff revisions concerning the Renewable Exemption will provide a clear framework and transparency which is beneficial to the market.

VI. Self Supply Exemption

- 74. I also actively participated in the NYISO's development of the Self Supply Exemption design and proposed tariff revisions, including making presentations to stakeholders and leading discussions with them on the Net Short Threshold and Net Long Threshold. The NYISO carefully considered the Order's guidance, Market Monitoring Unit, and stakeholder input when developing its proposed Self Supply Exemption.
- 75. I believe that the descriptions set forth in the Compliance Filing of the conceptual bases for the Self Supply Exemption, including the proposed Net Short Threshold and Net Long Threshold, and the design thereof are reasonable and accurate. I fully support the descriptions contained therein and the proposal.
- 76. In my opinion, as a subject matter expert in market power analysis and market power mitigation design for capacity markets, I believe that the proposed Self Supply Exemption makes available an opportunity for a Self Supply Exemption from Offer Floor mitigation for proposed new capacity projects, or existing projects that increase their CRIS, that have limited or no incentive to suppress capacity prices, while also providing adequate protections against the exercise of market power.
- 77. This concludes my affidavit.

ATTESTATION

I am the witness identified in the foregoing affidavit. I have read the affidavit and am familiar with its contents. The facts set forth therein are true to the best of my knowledge, information, and belief.

1/poparej Julia Popova /

Subscribed and sworn to before me this [/g] day of April 2016

Thomasine Delhaw Notary Public

My commission expires: $\frac{5/3i/19}{3i}$

THOMASINE DeSHAW NOTARY PUBLIC-STATE OF NEW YORK No. 01DE4513447 Qualified in Rensselaer County My Commission Expires May 31, 19