State of New York

Public Service Commission

Case 15-E-0302	Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard

NYSERDA Comments on the AWEA/ACE-NY Petition Regarding Integration of an Index REC Procurement Structure into Tier 1 REC Procurements Under the Clean Energy Standard

Submitted by the New York State Energy Research and Development Authority

October 2, 2019

1 Introduction

1.1 Context

On August 8, 2019, the New York Public Service Commission (Commission) issued a Notice[1] Soliciting Comments (Notice) in response to a petition[2] (Petition) filed on March 12, 2019 by the American Wind Energy Association (AWEA) and the Alliance for Clean Energy New York (ACE NY) under Case 15-E-0302, Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard (CES). The Petition requested that the Commission direct the New York State Energy Research and Development Authority (NYSERDA) to implement an Indexed Renewable Energy Credit (Index REC) procurement mechanism in future Tier 1 REC procurements under the CES.

The CES was adopted on August 1, 2016 through the Commission's Order Adopting a Clean Energy Standard (CES Order).[3] The CES Order adopted the goal that 50 percent of New York's electricity be generated by renewable resources by 2030 as part of New York' strategy to reduce statewide greenhouse gas emissions by 40 percent by 2030. The CES Order also called for long-term REC procurement solicitations to be administered by NYSERDA, under the Renewable Energy Standard (RES), as the primary means of delivering on the 50 percent goal. In accordance with the CES Order, all RES solicitations have used a Fixed REC procurement structure, under which winning projects receive a fixed, as-bid REC payment for eligible generation.

On July 12, 2018, the Commission issued the Order Establishing Offshore Wind Standard and Framework for Phase 1 Procurement (Offshore Wind Order)[4] which adopted a supplementary CES goal of developing 2,400 megawatts of offshore wind by 2030. In doing so, the Commission authorized NYSERDA to issue an offshore wind solicitation, using a dual-bid procurement approach that requires two separate bids from each participating bidder, one for a Fixed Offshore REC (OREC) and one for an Index OREC. According to the terms of the evaluation procedure, NYSERDA was given the authority to select either structure for contracting.

Most recently, on July 18, 2019, Governor Andrew M. Cuomo signed the Climate Leadership and Community Protection Act (CLCPA) which supported his Green New Deal commitments. Governor Cuomo's Green New Deal is the most aggressive climate and clean energy initiative in the nation, putting the state on a path to being entirely carbon-neutral across all sectors of the economy and establishing a goal to achieve a zero-carbon emissions electricity sector by 2040, faster than any other state.[5] The

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[1] Case 15-E-0302, *Notice Soliciting Comments* (August 8, 2019). Reply comments are due on November 15, 2019.
[2] Case 15-E-0302, *Statement by ACE NY and AWEA regarding the Petition submitted by Multiple Intervenors and the Independent Power Producers of New York, Inc. on July 9, 2018, and a Petition for an Order Modifying the Clean Energy Standard Tier 1 Procurement Process* (March 12, 2019).
[3] Case 15-E-0302, *Order Adopting a Clean Energy Standard* (August 1, 2016).
[4] Case 18-E-0071, *Order Establishing Offshore Wind Standard and Framework for Phase 1 Procurement* (July 12, 2018).
[5] The Office of Governor Andrew M. Cuomo. Governor Cuomo Executes the Nation's Largest Offshore Wind Agreement and Signs Historic Climate Leadership and Community Protection Act (July 18, 2019). https://www.governor.ny.gov/news/governor-cuomo-executes-nations-largest-offshore-wind-agreement-and-signs-historic-climate

CLCPA mandates that at least 70 percent of New York's electricity come from renewable energy sources by 2030 and that the State's power system be 100 percent carbon neutral by 2040. The legislation calls for the Commission to design programs to achieve these goals "at a reasonable cost while ensuring safe and reliable electric service."

The Petition asserts that use of an Index REC mechanism in Tier 1 REC procurements, similar to the Index OREC option introduced under the Offshore Wind Order, would provide various advantages including lower REC procurement costs as well as lower costs and less volatile prices for ratepayers. The Petition also states that an Index REC procurement mechanism would avoid a potential "double payment" to renewable generators in the event the New York Independent System Operator (NYISO) implements carbon pricing into New York's wholesale energy market.

1.2 Existing Large-Scale Renewables Policy Framework

Through the CES Order issued on August 1, 2016, the Commission adopted the goal that 50 percent of New York's electricity be generated by renewable resources and that statewide greenhouse gas emissions be reduced by 40 percent by 2030. The CES is divided into a RES and a Zero-Emissions Credit (ZEC) requirement. The RES includes a "Tier 1" program for new renewable resources and a "Tier 2" maintenance program. The CES Tier 1 program includes an "LSE Obligation" under which each New York LSE must procure new renewable resources as evidenced by the procurement of Tier 1 RECs. LSEs may meet their obligations by purchasing Tier 1 RECs from NYSERDA, purchasing Tier 1 RECs from other sources, or making Alternative Compliance Payments (ACPs) to NYSERDA.

The CES Order also authorized NYSERDA to conduct regular solicitations for the long-term procurement of RECs to support the CES goals using a Fixed REC procurement structure. This structure continues to be employed as the sole procurement structure in NYSERDA's Tier 1 REC solicitations. This option is presented here and analyzed in these comments as the base case to which the Index REC will be compared.

NYSERDA has completed two Tier 1 REC solicitations, RESRFP17-1 and RESRFP18-1. RESRFP17-1 resulted in the award of contracts for 26 new large-scale renewable energy projects representing 1,383 megawatts of installed capacity at a weighted average price of $21.71 per REC. RESRFP18-1 built on this success and awarded 19 projects representing 1,364 megawatts of installed capacity at a weighted average price of $18.52 per REC. Together, these projects are expected to generate enough clean energy to power more than 800,000 New York homes each year and reduce annual carbon emissions by more than 3 million metric tons. A third RES solicitation, RESRFP19-1, is underway, with awards expected in 2019.[6]

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[6] RESRFP19-1 is available at: https://www.nyserda.ny.gov/All%20Programs/Programs/Clean%20Energy%20Standard/Renewable%20Generators%20and%20Developers/RES%20Tier%20One%20Eligibility/Solicitations%20for%20Long%20term%20Contracts.

In the CES Order, in recognition of the State's significant offshore wind potential, the Commission considered offshore wind's possible role as a renewable resource. The Commission requested that NYSERDA study the appropriate mechanisms to develop offshore wind, which resulted in NYSERDA's release of the New York State Offshore Wind Master Plan (Master Plan) on January 29, 2018.[7] The Master Plan charts a course for the State to reach 2,400 megawatts of offshore wind capacity by 2030 and is supported by the Offshore Wind Policy Options Paper,[8] which was filed with the Commission for its consideration of an offshore wind procurement program.

The resulting Offshore Wind Order, issued on July 12, 2018, formally adopted a supplementary CES goal of developing 2,400 megawatts of offshore wind by 2030. The Offshore Wind Order authorized NYSERDA to issue an initial solicitation using a dual-bid procurement approach that requires two separate bids from each participating bidder, one for a Fixed OREC and one for an Index OREC. The two bids are weighted at 0.1 for the Fixed OREC and 0.9 for the Index OREC to calculate a single price for comparison across proposals. NYSERDA was given authority to select either procurement structure as the contracting mechanism.

On July 18, 2019, Governor Cuomo announced results from NYSERDA's first offshore wind procurement, ORECRFP18-1, as the single largest renewable energy procurement by any state in U.S. history. Awarding two projects, Empire Wind and Sunrise Wind, NYSERDA issued contracts for nearly 1,700 megawatts of offshore wind capacity, providing enough clean energy to power more than one million New York homes. This announcement advanced New York's now-expanded nation-leading mandate under the CLCPA to install 9,000 megawatts of offshore wind by 2035.

1.3 Objective and Organization of Comments

The CLCPA significantly expands the need for renewable energy development and reinforces the need to ensure that NYSERDA's procurement program strikes the optimal balance between considerations of cost effectiveness, feasibility, and market compatibility. These comments provide NYSERDA's analysis of these considerations and include a series of recommendations for the Commission's consideration regarding the most advantageous design characteristics of an Index REC structure.

In Section 2, NYSERDA summarizes its observations and recommendations for the Commission's consideration in the form of direct responses to the questions articulated in the Notice. The sections that follow provide analytic detail to support the conclusions in Section 2. Section 3 provides a high-level description of the main features of both the current Fixed REC procurement structure and the potential new Index REC approach. Section 4 lays out NYSERDA's qualitative assessment of the primary design choices associated with the Index REC structure. Section 5 presents quantitative analysis comparing REC cost projections between the Fixed REC structure and an alternative Index REC structure reflecting the relevant design choices identified in Section 3. These comments conclude with Appendix A, which includes additional detail regarding the assumptions used to support the quantitative analysis.

[7] New York State Offshore Wind Master Plan. https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Offshore-Wind-in-New-York-State-Overview/NYS-Offshore-Wind-Master-Plan.

[8] Case 18-E-0071, *NYSERDA's Offshore Wind Policy Options Paper* (January 29, 2018).

NYSERDA's quantitative analysis indicates that the introduction of an Index REC structure for New York's onshore large-scale renewables procurements could deliver cost-effectiveness benefits and corresponding reductions in program costs to ratepayers. Section 4 identifies a specific Index REC design variant that would align with important other objectives around market compatibility and implementation feasibility. Based on its experience in the implementation of renewable procurement mechanisms and specific analysis of the issues presented, NYSERDA recommends that the Commission adopt the recommended Index REC structure as a procurement mechanism for Tier 1 of the CES.

2 Responses to Notice Soliciting Comments

Responses to the Commission's specific questions as raised in the Notice are set out below.

1. *<u>Are there specific benefits, challenges, and/or considerations that should be addressed in considering an Index REC procurement mechanism?</u>*

Section 5 discusses the projected cost-effectiveness benefits of an Index REC as compared to the current Fixed REC procurement structure. In addition, introduction of an Index REC structure could potentially widen the pool of projects participating in Tier 1 REC procurements, thus increasing the competitiveness of the bidder pool while facilitating the achievement of New York's renewable mandates (and/or reduce the cost thereof). While not quantified in these comments, this potential supply expansion should be considered given the increased level of ambition embodied in New York's targets under the CLCPA.

Section 4 reflects Index REC design considerations to the extent expected to be relevant to the Commission's decision regarding adoption of an Index REC structure, and sets out a specific, recommended Index REC design variant.

2. *<u>Is the Index REC structure an appropriate pathway to address NYISO market changes and potential market reforms?</u>*

NYSERDA believes that the Index REC structure would provide increased flexibility and responsiveness, relative to the Fixed REC, to accommodate future market reforms and reduce ratepayer exposure to market volatility while also reducing the potential for unintended consequences. Since by its nature the Index REC structure is variable with respect to general market conditions, the incorporation of carbon pricing into energy and capacity prices would not result in double payments and would be expected to mitigate against other market changes.

3. *<u>Would the Index REC lower financing costs for renewable generators and lead to lower and less volatile prices for consumers?</u>*

NYSERDA's analysis supports the conclusion that Index RECs reduce projects' risk exposure, which should be expected to translate to lower financing costs, as is discussed in more detail in Section 5. The analysis carried out for these comments indicates that representative projects could see their REC price reduce by approximately $8 per MWh, which would correspond to more than a third of Fixed REC premiums in recent NYSERDA procurements.

The basic design of an Index REC structure with a fluctuating REC price means that REC payments will exhibit some degree of fluctuation as opposed to a Fixed REC structure. More importantly from the perspective of ratepayers, however, the effect will be that consumers will experience a dampening effect in their energy bills both when commodity prices go up and down since these fluctuations will follow commodity price fluctuations inversely, thus reducing their overall exposure to volatility.

4. *If an Index REC option were advanced, should NYSERDA continue to also solicit bids for Fixed REC structures? If yes, please explain why and also provide any details describing the preferred process to implement such an approach, including program design, evaluation and contracting considerations.*

NYSERDA expects the Index REC to support increased cost effectiveness and improved market compatibility relative to the Fixed REC, as is discussed in Sections 4 and 5. However, some renewable energy developers may have unique long-term market views, risk tolerances, and business models, which, when combined with project specific considerations, may result in some developers preferring to bid a Fixed REC structure rather than an Index REC. Parties who may prefer the Fixed REC include developers who balance-sheet finance their projects, projects that have their energy offtake contracted prior to bidding, or developers that have a long-term view of rising energy prices.

Under the Offshore Wind Order, bidders are required to submit bids for both the Fixed OREC and Index OREC structures (referred to as a "hybrid" structure). Bids are then evaluated by calculating a weighted average levelized net OREC cost for each bid package, with current weighting being 90 percent for the Index OREC and 10 percent for the Fixed OREC. While this approach has been successful for offshore wind procurements and is an option for the Commission to consider for the Tier 1 REC program, NYSERDA believes this approach is not optimal for Tier 1 procurements, which differ from offshore wind in that the market is more mature and more diverse (covering a wider range of technologies and project sizes), suggesting that a more flexible approach that allows projects to choose the preferred bidding structure could be more appropriate.

NYSERDA therefore recommends that the Commission consider allowing bidders to select their preferred procurement structure, either the Fixed REC or the Index REC, and to bid accordingly. Regardless of a bidder's chosen bid structure, bid prices would be evaluated by calculating the expected levelized net REC cost under each bid type. Bids under both structures would therefore be evaluated head-to-head using this single cost metric to ensure optimal cost effectiveness for ratepayers.

To the extent future procurements would continue to be conducted using the Fixed REC either as the sole or as one of the available procurement structures, amendments to future Fixed REC contracts to address potential market changes such as carbon pricing should be identified and considered, given that, contrary to Index RECs, Fixed RECs do not offer a suitable response to such changes.

5. *What are the most appropriate Index REC structures to address implementation issues such as the derivation of a Reference Energy Price and Reference Capacity Price, treatment of negative locational marginal based prices (LBMPs), bid evaluation methodology, and design considerations necessary to maintain appropriate market signals and an appropriate balance of risk between developers and ratepayers? Explain why those structures are viewed as most optimal.*

Section 4 sets out NYSERDA's views and recommendations on the most appropriate Index REC design selections to address issues, such as derivation of the Reference Price and treatment of negative LBMPs, that will impact the key objectives of cost effectiveness, market compatibility, and program feasibility. These are summarized below in Table 1.

Table 1:Design selections for the preferred Index REC variant.

Design Choice	Index REC Design Selection
Settlement Period	Monthly settlement period with a single Reference Price
Treatment of Negative REC Payments	Allow negative REC payments (from project to NYSERDA)
Reference Energy Price	
Market Choice	Hourly day-ahead LBMP
Geographic Precision	Zonal Reference Energy Price
LBMP Weighting	Simple averaging of hourly prices
Treatment of Negative LBMPs	Determine limits to the impact of negative LBMPs on REC pricing
Reference Capacity Price	
Market Choice	ICAP Spot Market Auction
Geographic Prevision	Single-locality Reference Capacity Price
UCAP Production Factor	Allow fixed and custom UCAP factors

Should the Commission adopt an Index REC structure, NYSERDA believes its past experience with both onshore large-scale renewables procurements and the first offshore wind procurement offers a robust foundation for determination of the most appropriate bid evaluation criteria for Index REC procurements, whether the structure be a potential parallel application of the Fixed REC, Index REC or any hybrid structure.

6. *Are there any other implementation issues associated with an Index REC procurement structure? Please describe such issues. If the Commission were to direct the adoption of indexed pricing, are there changes in program implementation, project selection, or other existing program rules that would be necessary or advisable?*

The adoption of an Index REC structure would require various implementation changes to the RES program, but none that appear unique or decision-critical, given NYSERDA's, the LSEs, and developers' past experience with both onshore large-scale renewables procurements and the first offshore wind procurement. One administrative process that would need to be developed is a revised methodology for NYSERDA to calculate its annual Tier 1 REC price associated with its sales to LSEs given the prospect of both fixed and variable REC payments, depending on the nature of the associated project agreements. NYSERDA suggests that this process should be the subject of an implementation plan.

3 Overview of Procurement Structures

3.1 Fixed REC

Under the current Tier 1 Fixed REC structure NYSERDA conducts procurements by issuing Requests for Proposals (RFP) for the RECs generated from eligible renewable projects. Bids are offered at a fixed price per REC (Fixed REC price) for the contract term. NYSERDA evaluates proposals and selects projects to award according to pre-determined price and non-price evaluation criteria.

Contracted projects deliver RECs generated through the contract term to NYSERDA for a fixed price per REC, subject to any contractually determined maximum quantities. This structure offers projects fully contracted RECs for the contract term at a known price while leaving energy and capacity to be sold by the project as it sees fit, whether into NYISO wholesale markets or through bilateral sales. Projects may also seek hedges from market counterparties to hedge commodity price risks.

NYSERDA resells the RECs it has procured from the project to the State's LSEs for compliance with their Tier 1 obligations. A visualization of this structure's cashflow is shown below in Figure 1.

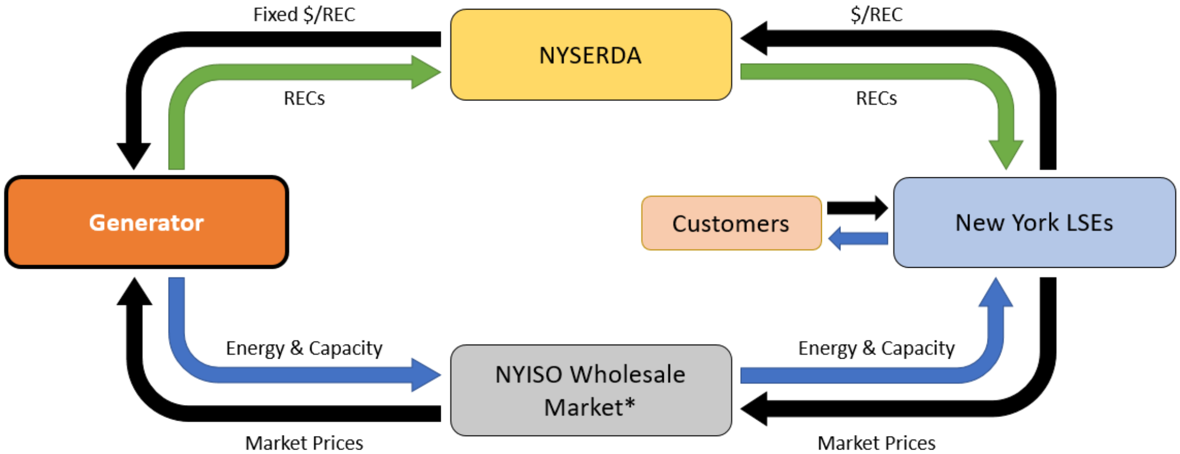

*Figure 1: Simplified cashflow summary of the Fixed REC procurement structure in its most generic form. *Note: generators are not required to sell into the NYISO wholesale market; they may enter into bilateral contracts.*

An advantage of the Fixed REC is that the fixed-price REC payments provide predictable cashflows for both NYSERDA and the project, allowing for a stable collection schedule from ratepayers and revenue confidence for the project. The primary challenge associated with the Fixed REC is that the contract structure offers only limited revenue certainty to project investors. While projects could take steps to hedge their energy or capacity revenue, this revenue risk is likely to increase the cost of project financing relative to a more fully-hedged contract structure.

3.2 Index REC

Several alternative procurement structures could be considered that would reduce projects' exposure to market price risk, with the aim of reducing costs to ratepayers. Such structures include, among others, Bundled Power Purchase Agreements (PPAs) and Index REC structures. Several prior NYSERDA publications have considered these alternatives, including the 2015 report "Large-Scale Renewable Energy Development in New York: Options and Assessment,"[9] the 2016 CES White Paper Cost Study[10] and the Offshore Wind Policy Options Paper. In accordance with the scope set out by the Notice, these comments are limited to consideration of the Index REC structure (in comparison with the Fixed REC structure discussed above).

The key distinction between the Index REC and Fixed REC structures is the way in which the REC price is determined. Index REC bids are offered as an Index REC Strike Price that reflects the all-in revenue

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[9] Case 15-E-0302, *Large Scale Renewable Energy Development in New York Options and Assessment* (June 1, 2015).
[10] Case 15-E-0302, *Clean Energy Standard White Paper – Cost Study* (April 8, 2016).

requirement of the project per unit of energy generated. This all-in Strike Price is set as a fixed schedule for the contract period. Under this structure, the effective REC price would be calculated as the as-bid Strike Price minus a referential value of energy and capacity (respectively, the "Reference Energy Price" and "Reference Capacity Price", and together, the "Reference Price", as discussed in Section 4). The Reference Price will vary over time as commodity prices fluctuate, and accordingly the REC price – paid by NYSERDA - will fluctuate as well. As is currently the case for Tier 1 RECs, NYSERDA would resell the RECs it has procured from the project to the State's LSEs for compliance with their LSE Obligation. The fluctuating Index REC prices would require NYERDA to forecast REC prices on a rolling basis to ensure collections from LSEs are sufficient to cover future REC costs. A visualization of this structure's cashflow is shown below in Figure 2.

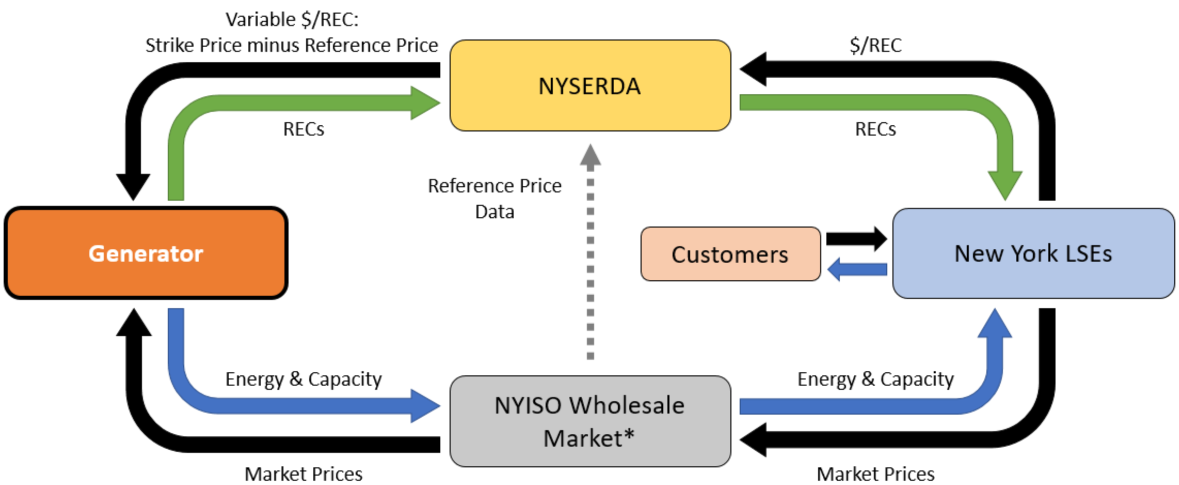

*Figure 2: Simplified cashflow summary of the Index REC procurement structure in its most generic form. *Note: generators are not required to sell into the NYISO wholesale market; they may enter into bilateral contracts.*

Conceptually, this structure offers projects a relatively more certain amount of revenue per unit of energy generated in the form of a hedge against fluctuations in commodity prices over time, creating price stability for both ratepayers and projects. For projects, this price stability translates to reduced project risk and resulting lower financing costs, as is explored more fully in Section 5. Ratepayers benefit from these lower financing costs through lower Strike Prices and hence lower REC payments, while price stability also reduces their exposure to volatility in electricity markets. Because ratepayers ultimately bear the burden of both direct energy costs and CES program costs, and because under an Index REC structure these program costs reduce when energy prices increase and vice versa, the overall price volatility customers bear from both upward and downward energy price movements is reduced.

As in the current Fixed REC structure, a project may sell energy and capacity as it chooses, whether into NYISO wholesale markets or through bilateral sales, but even if the project decides to sell into the wholesale markets, the hedge provide by an Index REC structure will not be fully "perfect," because, depending on the design choices of an Index REC structure (as discussed in more detail in Section 4), a degree of deviation will occur between the Reference Price used to calculate the net premium payments under the Index REC structure and the generator's actual achieved prices from commodity (energy and capacity) sales. This potential deviation is referred to as basis risk. Figure 3 below conceptually illustrates how differences between the Reference Price and the generator's achieved market prices can result in a shortfall or surplus relative to the generator's Index REC Strike Price.

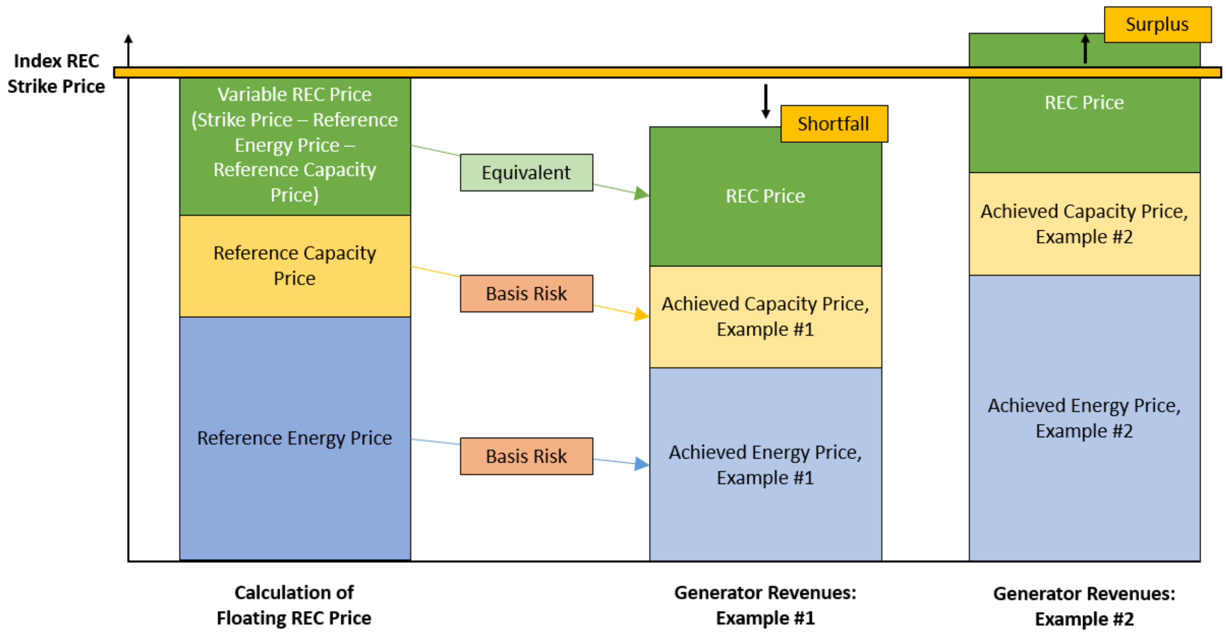

Figure 3: Example of commodity basis risk in the Index REC procurement structure.

Because the REC payment is calculated based on the Reference Price, if the Reference Price exceeds the generator's actual achieved energy revenues, the generator will see a shortfall; if the Reference Price is less than the generator's actual achieved energy revenues, the generator will see a surplus.

As noted, New York's Offshore Wind Standard has implemented both the Fixed REC and Index REC structures for use in respect of offshore wind procurements, the latter being referred to as "Index ORECs." The existing Index OREC structure and NYSERDA's recent experience in implementing this approach serves as a benchmark for NYSERDA's assessment of the design approach to a possible Index REC structure for onshore renewables, discussed in the following section.

4 Qualitative Index REC Design Choices

The development of an Index REC structure requires several important design choices that NYSERDA believes will be relevant to the Commission's decision of whether to adopt the Index REC structure with respect to ratepayer impacts, administration of the resultant long-term contracts, maintenance of market incentives, and responsiveness to uncertain and dynamic energy markets. This section assesses the available options for such features and establishes "design selections" for each which, together, comprise a specific, preferred Index REC variant for comparison with the current Fixed REC structure in subsequent sections of these comments.

The assessment criteria used in this paper are broadly the same as those employed in the assessment of Index ORECs and other offshore wind procurement structures in the Offshore Wind Policy Options Paper:[11]

- Cost Effectiveness: evaluation of the structure's ability to minimize REC costs to ratepayers, which is driven by the quality of the structure's hedge against uncertainty of wholesale energy and capacity market prices, and its impact on basis risk as discussed in Section 3.2.
- Market Compatibility: evaluation of the structure's ability to maintain important aspects of the operation of New York's electricity markets, e.g. to encourage the project to maximize generation during peak hours and locate the project in areas of high demand (high-price nodes). In addition, accommodation of potential market structure changes, such as carbon pricing, will be considered.
- Feasibility: evaluation of the structure's implementation and program management complexities.

4.1 Settlement Period

The Reference Price (both the Reference Energy Price and the Reference Capacity Price) would be calculated at regular intervals throughout the contract period to determine REC payments. The duration of this interval, referred to here as the "settlement period," is relevant for two reasons. First, the length of the settlement period will influence the effectiveness of the hedge, with a shorter settlement period offering more hedging precision (and greater cost effectiveness) than a longer settlement period. Second, a longer settlement period may impede timely REC payments, delaying cashflow to the project and risking increased financing costs and reduced cost effectiveness.

The settlement period could reasonably range from hourly to monthly, as any shorter would have no incremental cost effectiveness benefit and any longer would risk increasing financing costs for no gains in market compatibility or feasibility. As discussed below, the NYISO capacity market only supports monthly pricing, making shorter settlement periods immaterial to the quality of the capacity hedge. The NYISO day-ahead energy market – also discussed in more detail below – supports hourly pricing, making an hourly settlement period the most precise energy hedging option. While hourly or daily calculation of the Reference Energy Price could enhance hedge quality, a monthly settlement period would strengthen the structural incentive for the project to maximize generation during peak pricing periods. That is, by selecting a settlement period that exposes the project to pricing fluctuations within such settlement period, the project would be economically incentivized to prioritize generation for high-price periods.

A daily or monthly settlement period could also be comprised of two sets of Reference Energy Prices, one for peak hours and one for off-peak hours. This option may provide a marginally more perfect energy hedge due to shorter effective settlement periods (dividing each settlement period into two pieces) but would also result in a loss of structural incentive for the project to prioritize generation during peak hours, offering benefits of cost effectiveness but drawbacks of market compatibility.

Design selection: monthly settlement period with a single Reference Price

[11] See Offshore Wind Policy Options Paper at 25.

4.2 Treatment of Negative REC Payments

Global evidence demonstrates that renewable pricing is highly sensitive to technology costs. As renewable technology costs continue to fall, Index REC Strike Prices would be expected to fall as well, reducing the premiums (REC payments) required to support project development. Lower Strike Prices, combined with the possibility of rising energy prices over time (through either natural market dynamics or a structural change in the NYISO wholesale market such as the integration of carbon pricing), could reduce Index REC payments over time to the point where, either for short or long periods of time, the Reference Price would exceed the Strike Price. Because under the Index REC structure, REC payments to a project would be equal to the project's generation multiplied by the amount by which the Strike Price exceeds the Reference Price, consistent application of this structure suggests that in periods where the Reference Price exceeds the Strike Price, projects would make net payments to NYSERDA. This is mechanically consistent with the existing Index OREC structure under the Offshore Wind Order.

Alternatively, the structure could apply a floor of zero or some other nominal value to REC payments during these periods, eliminating the possibility of payments from the project. NYSERDA believe that this option would be at odds with the fundamental ambitions of an Index REC structure, which is intended to maximize program cost effectiveness by reducing project revenue uncertainty. A structure that provides projects with the certainty of a fixed revenue level per megawatt hour at the Strike Price, even when energy prices drop, implies that ratepayers should receive the corresponding benefits of potential long-term commodity price increases.

If negative REC payments (by the generator to NYSERDA) are structurally permitted, the mechanics of an Index REC contract should ensure that the risk of negative REC prices does not place a material burden on projects by requiring them to have sufficient liquidity to settle negative payments for a given settlement period. The establishment and maintenance by projects of reserves or other financing instruments to manage this risk could result in increased financing costs and reduced cost effectiveness of the Index REC structure. To maintain the benefits of negative REC prices and retain cost effectiveness, an Index REC contract could include payment terms that would ensure that any REC payments due from projects would not need to be made until after projects would typically have received payment for their commodity sales. This could include a debit mechanism where a settlement period's negative REC value is carried forward to the following settlement period rather than being settled immediately.

Design selection: allow negative REC payments (from project to NYSERDA)

4.3 Reference Energy Price – Market Choice

The NYISO publishes LBMP data in three forms: (i) Hourly Day-Ahead; (ii) Hourly Real-Time; and (iii) 5-Minute Real-Time. Together, these summarize the pricing of the two distinct markets (day-ahead and real-time) available to a project. The NYISO wholesale energy market incorporates generation from both markets to fulfill its delivery requirements, with the day-ahead market committing most of system load and the real-time market acting as a mechanism to balance day-ahead commitments against real-time load. For the purpose of calculating the Reference Energy Price (and thus the REC price), an Index REC structure would need to choose one of these markets or a combination thereof.

Use of either market would be similar from the perspectives of feasibility and market compatibility. The day-ahead market is based on optimal operating conditions whereas the real-time market balances supply and demand in consideration of system load, constraints, and outages. These dynamics cause the day-ahead market to be marginally more stable than the real-time market, which could lead to modest cost effectiveness benefits because of the impact this stability would have on the predictability of the Reference Price. This improved predictability could in turn directly lead to a lower Strike Price bid (due to reduced revenue uncertainty) from a given project.

Design selection: hourly day-ahead LBMPs

4.4 Reference Energy Price – Geographic Precision

The NYISO publishes LBMPs in each of the forms listed above at two levels of precision: (i) average at each reference bus, and (ii) average within each NYISO load zone. For projects that choose to participate in NYISO's wholesale market, their actual energy revenue will be determined by the LBMPs at the bus where they are injecting. The Reference Energy Price could reflect the LBMP from such project's actual reference bus (providing a more optimal hedge) or the average LBMP for the project's NYISO zone of delivery. Alternatively, zonal data could be aggregated to form a multi-zonal or even a statewide Reference Energy Price, creating a wide range of options for the geographic precision of the energy hedge.

While a Reference Energy Price reflecting LBMPs at each project's bus would increase cost effectiveness, this approach could raise concerns regarding both feasibility and market compatibility (obscuring market incentives for a project to deliver into high-price buses). A Reference Energy Price reflecting average zonal prices would directly address both of these concerns. It is noted that the Offshore Wind Order applies further aggregation of the Reference Energy Price into a multi-zonal index, but this reflects the limited geography of injection points for offshore wind projects. For land-based projects, there is no clear rationale or methodology for pursuing a multi-zonal Reference Energy Price. While a multi-zonal index could nevertheless yield some benefits in the form of reduced administrative burdens, these would be outweighed by reductions in cost effectiveness due to a less precise energy hedge for land-based renewable projects.

Design selection: zonal Reference Energy Price

4.5 Reference Energy Price – LBMP Weighting

Depending on the selections made for the settlement period, market choice, and geographic precision of the Reference Energy Price, various options are also available regarding weighting of different time intervals for calculation of the Reference Energy Price. If the Reference Energy Price is a monthly index based on hourly, zonal day-ahead LBMPs, the hourly LBMPs may be weighted equally across the month or weighted by calculated weighting factors; in the latter case such weighting could be based on the generator's actual generation profile, a generic technology generation profile for the generation technology used by the project in question, aggregate zonal load across all generation technologies, or other weighting factors.

These weighting considerations may not only impact the cost effectiveness of the hedge but may also strengthen or weaken structural incentives for the project to shift available generation as much as possible to high-price periods. Using the generator's actual generation profile for weighting, while offering the most precise and cost-effective energy hedge, would diminish or eliminate the project's exposure to these market incentives. Other weighting options, such as by zonal load, by a generic technology generation profile, or by means of simple averaging of hourly prices across the settlement period would be expected to result in only minor differences regarding cost effectiveness and feasibility. Some technologies, particularly solar, may benefit from weighting by a generic technology generation profile because of solar generation's relatively consistent temporal distribution. Wind technology, on the other hand, faces more variable generation profiles and therefore may not benefit from such weighting. Use of simple average weighting would provide comparable hedging benefits for all technologies and offer lower administrative complexity.

Design selection: simple averaging of hourly prices across the settlement period

4.6 Reference Energy Price – Treatment of Negative LBMPs

In any settlement period, some LBMPs may be negative, reflecting periods where a project would have to pay customers to take their generation, curtail production, or utilize paired storage facilities. Despite negative prices, projects may still choose to generate because of high shutdown/startup costs (in the case of some conventional generators) or to capture federal production tax credits or Fixed REC payments (in the case of renewable generators under the current procurement model).

During these periods, ratepayers could potentially be exposed to a potentially uncapped upward price effect on REC prices in any settlement period depending on the extent and duration of any negative LBMP periods in the period. At the same time, renewable generation during low-price periods may still displace conventional generation and would therefore still offer ratepayers value through the environmental value it provides as embodied in the REC. Accordingly, NYSERDA believes that a balance should be struck between limiting ratepayer exposure and ensuring that environmental value is appropriately compensated.

There are several structural options to consider for the treatment of negative LBMPs in the calculation of the Reference Energy Price, including: (i) treat negative LBMPs the same as positive LBMPs (i.e. fully included in the calculation of the Reference Energy Price as per the LBMP weighting options discussed above); (ii) apply a floor of zero or some nominal value to LBMPs used in the calculation of the Reference Energy Price; (iii) apply a ceiling for the REC price in any given settlement period at the Strike Price or some other nominal value; or (iv) apply a ceiling of some nominal value to the REC price payable for RECs generated during negative LBMP periods only.

Under option (i), ratepayers would be exposed to the aforementioned uncapped upward price effect on REC prices depending on the extent and duration of any negative LBMP periods. Options (ii) and (iii) attempt to strike a balance between REC value and REC price exposure by limiting the extent to which negative LBMP periods would drive up the overall REC price in any given settlement period; option (iv) would achieve this balance by distinguishing between a REC Price made available during negative LBMP periods and the REC price for other periods. NYSERDA suggests that, should the Commission decide in favor of the Index REC, a more specific approach to negative LBMPs would be determined from the range of options described by options (ii), (iii) and (iv).

Design selection: determine limits to the impact of negative LBMPs on REC pricing

4.7 Reference Capacity Price – Market Choice

The NYISO installed capacity market consists of three auction structures: (i) the Monthly Auction; (ii) the Capability Period Auction; and (iii) the ICAP Spot Market Auction. New York's LSEs utilize these three auctions to fulfill their Installed and Unforced Capacity (UCAP) requirements as determined by the NYISO. Any of these auction structures may be feasible for calculation of the Reference Capacity Price.

In Monthly Auctions, UCAP may be purchased and sold for the upcoming month or any other month in the active capability period, which runs for six months. Participation in these auctions is voluntary, and transaction volume is generally considerably smaller than the ICAP Spot Market Auctions.

Capability Period Auctions take place at the start of each capability period, or every six months, and facilitate the purchase and sale of UCAP for the entirety of the capability period. Participation in these auctions is voluntary, and transaction volume is generally considerably smaller than the ICAP Spot Market Auctions.

All LSEs are required to participate in each monthly ICAP Spot Market Auction, during which the NYISO submits bids for the upcoming month on behalf of all LSEs at a price determined by the applicable ICAP Demand Curve.[12] This is the largest of the three auction structures and provides robust investment price signals to projects.

All auction structures provide comparable levels of feasibility and market compatibility. The ICAP Spot Market Auction, however, offers incremental cost effectiveness because this is the vehicle most projects are expected to utilize to sell their capacity, meaning the capacity hedge quality would be optimized by tying the Reference Capacity Price to this auction structure.

Design selection: ICAP Spot Market Auction

4.8 Reference Capacity Price – Geographic Precision

Transmission constraints within the New York Control Area (NYCA) necessitate location-specific UCAP requirements across three NYISO-designated localities: (i) New York City; (ii) Long Island; and (iii) the G-J Locality. The remainder of the NYCA is grouped together as Rest of State (ROS). Across each of the capacity auction structures listed above, pricing data is aggregated for each NYCA locality.

The Reference Capacity Price may be calculated using the locality-specific prices, or alternatively, locality data could be aggregated to create a multi-locality or even statewide Reference Capacity Price. The Offshore Wind Order applies a multi-locality approach to determining the Reference Capacity Price for ORECs, but as noted in Section 4.4 in respect of Reference Energy Prices, this approach reflects the specific circumstances of offshore wind projects. For land-based projects, pursuing a multi-locality Reference Capacity Price would reduce capacity hedge quality and cost effectiveness while offering no incremental benefits to feasibility or market compatibility.

[12] New York Independent System Operator. *Manual 4, Installed Capacity Manual* (August 26, 2019). See Section 5.4 at 162.

Design selection: single-locality Reference Capacity Price

4.9 Reference Capacity Price – UCAP Production Factor

UCAP represents the amount of generating capacity that a power resource can be reasonably expected to contribute during peak hours. A project's UCAP value as a percentage of their Installed Capacity is referred to here as the "UCAP Production Factor." UCAP values for operational assets are calculated regularly throughout the asset's life based on the project's operational performance to ensure the asset's reliability value is properly reflected in the capacity market. Until such operational data is available, however, an intermittent power resource will be awarded a UCAP value using a standard unforced capacity percentage (referred to here as "NYISO UCAP Production Factor") as defined in Section 4.5 of the NYISO Installed Capacity Manual.

An intermittent project participating in the NYISO capacity market is expected to receive capacity revenues equal to its UCAP value multiplied by the applicable market clearing price (referred to here as the "Reference UCAP Price"). In the Index REC structure, the Reference UCAP Price would be converted to its dollar-per-megawatt hour equivalent, the Reference Capacity Price, by multiplying the Reference UCAP Price by the project's installed capacity and the UCAP Production Factor and dividing this product by the quantity of the project's generation in the settlement period.

To create an optimal hedge, the UCAP Production Factor may change throughout the contract term to reflect the active UCAP value as confirmed by the NYISO. Alternatively, a fixed UCAP Production Factor could be used throughout the contract term, reflective of either the NYISO UCAP Production Factor or a custom value as chosen by the project.

If the UCAP Production Factor were dynamic to reflect the project's active NYISO-confirmed UCAP value, the project would have no direct incentive to increase its UCAP value because it would have obtained a perfect hedge against this UCAP risk. Instead, a structure that keeps the UCAP Production Factor fixed throughout the contract term would retain the incentive for the project to maximize its UCAP factor, enhancing the overall structure's market compatibility.

When using a fixed UCAP Production Factor value, the Index REC structure could allow projects to choose their own desired values – as is currently the case in the Index OREC structure – since this would have no material impact on the cost effectiveness, feasibility, or market compatibility. Allowing a project to select a custom UCAP Production Factor gives optionality and opportunity for optimization as projects see fit.

Design selection: allow fixed, custom UCAP Production Factors

5 Quantitative Assessment

5.1 Summary of Approach

NYSERDA has quantitatively assessed the Index REC and Fixed REC structures by estimating the expected prices of Tier 1 RECs under each structure. The Fixed REC was analyzed according to its existing structure under the CES and the Index REC was analyzed according to the design choices identified in Section 4.[13] The methodology utilized for calculation of REC pricing is summarized below and is consistent with the analytic approach taken for the Offshore Wind Policy Options Paper which supported the Offshore Wind Order. A more detailed summary of this methodology can be found within the Offshore Wind Policy Options Paper.[14]

To most accurately estimate the REC prices under both procurement structures, NYSERDA utilized a financial modeling approach that was meant to replicate the actual REC bidding strategy of market participants. NYSERDA constructed a tool that modeled the financial performance of a given project and calculated the internal rates of return (IRR) for investors in a generic project finance structure, which was assumed to include both debt and equity investors. Using inputs such as capital costs, operating costs, generation profiles, and debt terms and pricing, this tool calculated the REC price required by a given project to achieve the hurdle rate of its equity investor.

Under both a Fixed REC and an Index REC procurement structure, the debt investor was assumed to finance only against hedged revenues and to size its investment such that principal and interest could be covered in downside revenue scenarios. The primary difference between the modeling of the Fixed REC and Index REC was the determination of the hedged revenues that would be valued by a debt investor, in particular regards to energy and capacity sale revenues. For this analysis, NYSERDA utilized an energy price forecast in accordance with the NYISO 2017 Congestion Assessment and Resource Integration Study (CARIS)[15] as well as the New York Department of Public Service's (DPS) latest capacity price forecast.[16] Because a Fixed REC structure offers no direct hedge against energy and capacity prices, a debt investor in this scenario was assumed to finance against any REC revenues and projected commodity revenues (energy and capacity) for the first five years of project operation, reflecting an assumption that projects could access a five-year commodity hedge in the market. By contrast, the hedging benefits of an Index REC structure were assumed to enable debt investors to finance against both REC and commodity revenues for the full term of the debt. The incremental leverage under the Index REC structure reduces the project's overall finance cost (weighted average cost of capital or WACC). This in turn reduces the REC price, relative to the Fixed REC, that is required to achieve the equity hurdle rate.

As discussed in Section 3.2, the Index REC structure does not offer a perfect hedge against energy and capacity prices (basis risk), a nuance which was captured in the quantitative assessment by incorporating an analysis of historic bus and zonal pricing within the NYISO. Both debt and equity investors were assumed to value REC prices according to the expected differences between market prices (e.g. the energy revenue achieved at the project's reference bus) and the Reference Price as determined by the Index REC structure.

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[13] Section 4 offers many specific design selections for the Index REC but also is non-specific in its recommendation for the treatment of negative LBMPs. However, NYSERDA does not believe the impact of that design selection to be material in the relative quantitative evaluation between the Fixed and Index REC structures.
[14] See Offshore Wind Policy Options Paper at Appendix B.
[15] New York Independent System Operator. *2017 CARIS Report* (April 2018).
[16] Case 14-M-0101, *ICAP Spreadsheet* (May 2, 2018).

NYSERDA examined the relative cost effectiveness of the Fixed REC and Index REC by assessing four reference installations in its analysis: small solar, large solar, small wind, and large wind. The analysis is thus able to test any cost-effectiveness differences from economies of scale and differences in hourly generation profiles between technologies. A larger project would be expected to be exposed to smaller unitized capital and operational costs, increasing the leverage (debt quantum as a percent of total capital costs) and thereby reducing the weighted average cost of capital (WACC). Additionally, due to the Index REC weighing all hours equally in the calculation of the Reference Energy Price (see discussion in Section 4.5) the quality of the energy hedge could differ between technologies that have varying hourly generation profiles.

This analysis serves to illustrate the relative cost effectiveness of Fixed RECs and Index RECs but should not be taken as constituting a projection of expected REC price levels under either procurement structure in future NYSERDA procurements. Bid prices in Tier 1 auctions will reflect the pool of bidding projects, which may or may not be represented by the four reference installations noted above, and the market dynamics facing those bidding projects, which may or may not be comparable to the assumptions used in this analysis.

This analysis assessed reference installations with commercial operation dates (COD) in 2023, reflective of renewable projects that would currently be under development. Reference installations were modeled in each of the eleven NYISO zones and the resulting REC prices were subsequently averaged according to each reference installation's zonal distribution by megawatt hour in the previous two Tier 1 REC procurements, RESRFP17-1 and RESRFP18-1.

The inputs utilized for each reference installation are shown below in Table 2. For brevity, Table 2 shows inputs for NYISO Zone C only. Please see Appendix A for additional details regarding modeling inputs.

Table 2: Modeling inputs for the four reference installations utilized in the quantitative assessment.

Input	Small Solar	Large Solar	Small Wind	Large Wind
Project Capacity, MW	20	200	50	300
Asset Life, years	25	25	25	25
CAPEX, $/kw	$889.4	$729.3	$1,462.7	$1,271.9
Levelized OPEX, $/kw-year	$28.2	$24.5	$51.6	$51.6
P50 Capacity Factor, %	16%	16%	35%	35%
P99 Capacity Factor, %	11%	11%	26%	26%
Equity After-Tax IRR, %	6.5%	6.5%	7.5%	7.5%
Cost of Debt, %	5.3%	5.3%	5.3%	5.3%
Debt Term, years	15	15	15	15
P99 Coverage Ratio[17]	1.0	1.0	1.0	1.0

[17] The coverage ratio refers to the ability of a project to pay its current debt obligations, calculated in this assessment as the ratio between the cash available for debt service and the current principal and interest payments due.

5.2 Key Findings

As shown below in Figure 4, the Index REC structure was found to result in significantly lower projected REC prices than the Fixed REC structure, consistent with the findings that the Offshore Wind Policy Options Paper described with respect to offshore wind procurement structures. REC price differentials between the Fixed REC and Index REC were consistent across the four reference installations; though wind projects showed a slightly larger differential, demonstrating that the Index REC structure may offer slightly better hedging quality for wind technologies than for solar technologies. For all reference installations, however, NYSERDA found the Index REC structure offered REC pricing benefits of approximately $8 per megawatt hour or more.

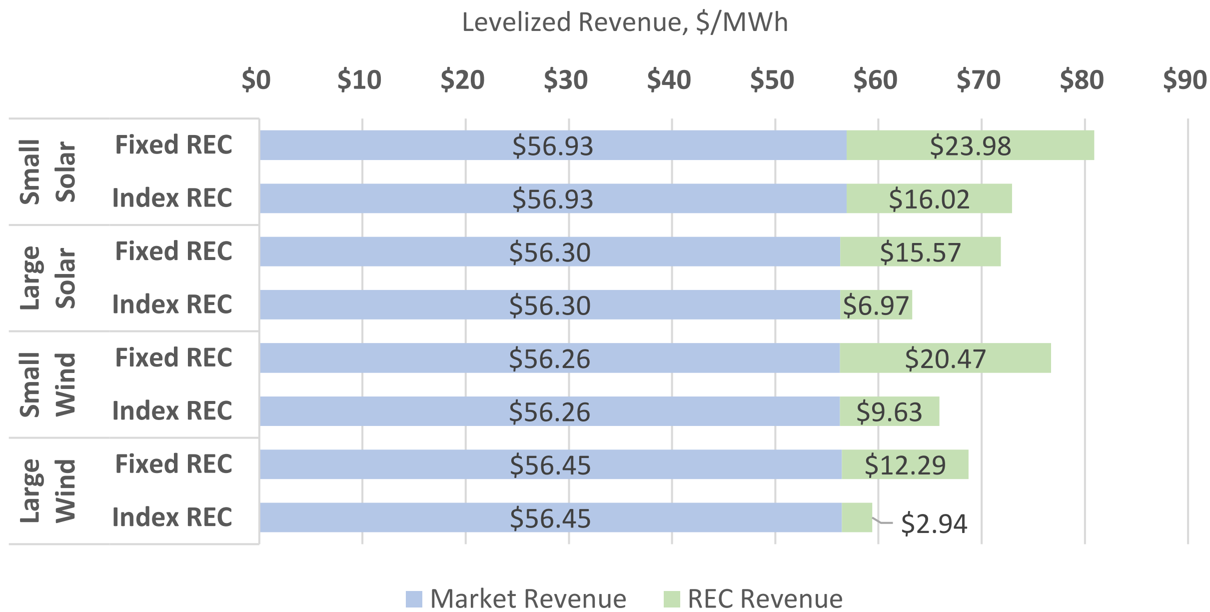

Figure 4: Levelized cost of electricity for each reference installation under both the Index REC and Fixed REC procurement structures. The levelized costs are broken down between market revenues and REC revenues.

Consistent with previous analyses, the projections described above thus support the expectation that an Index REC structure could provide significant cost-effectiveness benefits compared to the current Fixed REC structure. Appendix A includes additional modeling assumptions and outputs.

Appendix A

This appendix includes detailed inputs critical to the quantitative analysis discussed in Section 5. First, Table 3 shows project value, operating cost, and generation data for each reference installation across NYISO zones A-F. Throughout these comments, zones G-K are not considered because there are no existing Tier 1 REC contracts for projects in those zones. Table 4 shows the distribution of each reference installation, by contracted Tier 1 RECs, across the relevant NYISO zones. Finally, Table 5 and Table 6 show relevant outputs for each reference installation under the Fixed REC and Index REC procurement structures, respectively. These outputs include levelized market and REC revenue, total project value, finance costs, debt value, and leverage percentage.

Table 3: Modeling inputs for the four reference installations across all NYISO zones that contain projects under development with existing Tier 1 REC awards.

Input, NYISO Zone A	Small Solar	Large Solar	Small Wind	Large Wind
Project Value, $/kw	$889.4	$729.3	$1,462.7	$1,271.9
Levelized OPEX, $/kw-year	$28.2	$24.5	$51.6	$51.6
P50 Capacity Factor, %	17%	17%	35%	35%
P99 Capacity Factor, %	11%	11%	26%	26%
Input, NYISO Zone B	Small Solar	Large Solar	Small Wind	Large Wind
Project Value, $/kw	$889.4	$729.3	$1,462.7	$1,271.9
Levelized OPEX, $/kw-year	$28.2	$24.5	$51.6	$51.6
P50 Capacity Factor, %	17%	17%	35%	35%
P99 Capacity Factor, %	11%	11%	26%	26%
Input, NYISO Zone C	Small Solar	Large Solar	Small Wind	Large Wind
Project Value, $/kw	$889.4	$729.3	$1,462.7	$1,271.9
Levelized OPEX, $/kw-year	$28.2	$24.5	$51.6	$51.6
P50 Capacity Factor, %	16%	16%	35%	35%
P99 Capacity Factor, %	11%	11%	26%	26%
Input, NYISO Zone D	Small Solar	Large Solar	Small Wind	Large Wind
Project Value, $/kw	$889.4	$729.3	$1,462.7	$1,271.9
Levelized OPEX, $/kw-year	$28.2	$24.5	$51.6	$51.6
P50 Capacity Factor, %	17%	17%	35%	35%
P99 Capacity Factor, %	12%	12%	26%	26%
Input, NYISO Zone E	Small Solar	Large Solar	Small Wind	Large Wind
Project Value, $/kw	$889.4	$729.3	$1,462.7	$1,271.9
Levelized OPEX, $/kw-year	$28.2	$24.5	$51.6	$51.6
P50 Capacity Factor, %	16%	16%	35%	35%
P99 Capacity Factor, %	11%	11%	26%	26%
Input, NYISO Zone F	Small Solar	Large Solar	Small Wind	Large Wind
Project Value, $/kw	$889.4	$729.3	$1,462.7	$1,271.9
Levelized OPEX, $/kw-year	$28.2	$24.5	$51.6	$51.6
P50 Capacity Factor, %	18%	18%	35%	35%
P99 Capacity Factor, %	12%	12%	26%	26%

Table 4: Distribution of each reference installation across NYISO zones.

NYISO Zone	Small Solar	Large Solar	Small Wind	Large Wind
Zone A	4%	22%	18%	30%
Zone B	1%	0%	0%	0%
Zone C	9%	20%	30%	41%
Zone D	0%	14%	0%	22%
Zone E	7%	24%	52%	7%
Zone F	79%	20%	0%	0%
Total	100%	100%	100%	100%

Table 5: Levelized project revenues, project values, financing costs, and debt values for each reference installation under the Fixed REC procurement structure. All metrics are $/MWh unless otherwise noted.

	Small Solar	Large Solar	Small Wind	Large Wind
Levelized Cost of Electricity	$80.91	$71.86	$76.74	$68.74
Levelized Market Revenues	$56.93	$56.30	$56.26	$56.45
Levelized REC Revenues	$23.98	$15.57	$20.47	$12.29
Project Value, $000	$17,787	$145,855	$73,133	$508,754
After-Tax Cost of Equity, %	6.5%	6.5%	7.5%	7.5%
Pre-Tax Cost of Debt, %	5.3%	5.3%	5.3%	5.3%
Debt Quantum, $000	$3,941	$30,693	$22,162	$131,622
Leverage, %	22.2%	21.0%	30.3%	25.9%

Table 6: Levelized project revenues, project values, financing costs, and debt values for each reference installation under the Index REC procurement structure. All metrics are $/MWh unless otherwise noted.

	Small Solar	Large Solar	Small Wind	Large Wind
Levelized Cost of Electricity	$72.95	$63.27	$65.89	$59.39
Levelized Market Revenues	$56.93	$56.30	$56.26	$56.45
Levelized REC Revenues	$16.02	$6.97	$9.63	$2.94
Project Value, $000	$17,787	$145,855	$73,133	$508,754
After-Tax Cost of Equity, %	6.5%	6.5%	7.5%	7.5%
Pre-Tax Cost of Debt, %	5.3%	5.3%	5.3%	5.3%
Debt Quantum, $000	$8,862	$74,424	$44,151	$286,835
Leverage, %	49.8%	51.0%	60.4%	56.4%