STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

NEW YORK RENEWABLE PORTFOLIO STANDARD COST STUDY REPORT II

VOLUME A

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CASE 03-E-0188 REVISED: FEBRUARY 27, 2004

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NY RPS COST STUDY REPORT II

VOLUME A

I. INTRODUCTION AND OVERVIEW

In meeting the needs of retail electric customers, New York State supports the commercialization and development of significant new renewable energy supplies to increase energy resource diversity and to reduce air emissions. To realize these objectives, State policies should be based on long-term, incremental strategies designed with an understanding of relevant economic, environmental, service reliability and equity considerations. To that end, the New York Public Service Commission (Commission) instituted a proceeding, Case 03-E-0188, to develop and implement a renewable portfolio standard (RPS) for electric energy retailed in New York State to increase the renewable energy share of New York's electric supply from the current level (current projected year 2005 level is approximately 20%) to 25%. The Commission also directed the parties to examine appropriate methodologies for assessing benefits and costs of the RPS and how to balance that analysis with other factors.

Staff of the Department of Public Service (Staff) has prepared this report as a collaborative effort, with significant input from Sustainable Energy Advantage, LLC (including its subcontractor, La Capra Associates) and assistance from the New York State Energy Research and Development Authority (NYSERDA). The purpose of this report is to provide an estimate of the potential direct ratepayer costs to New York's retail electric customers of the implementation of an RPS to increase the renewable energy share of New York's electric supply from the current level to 25% by the year 2013. A secondary purpose of the report is to provide estimates of (a) the contribution of different resource types to meeting the RPS and (b) the displacement of existing generation sources and their air emissions. The report does not attempt to fully quantify the indirect fuel diversity/energy security, public health, or economic development benefits of the implementation of the RPS.

This Cost Study Report II is a revised and more comprehensive study undertaken at the request of Administrative Law Judge Eleanor Stein. Volume A reports the study of the Prime Case proposed by Staff. Volume B will report the study of numerous sensitivities to the Prime Case as well as numerous alternatives to the Prime Case proposed by parties to Case 03-E-0188.

Section II of this volume summarizes the results of the analysis. Section III gives an overview of the various methodologies utilized in the analyses. Section IV sets forth the key assumptions made in conducting the various analyses reported. Section V describes in detail each component analysis, including direct impacts and indirect impacts. Finally, Section VI gives the key conclusions and implications that can be drawn from the results. In Appendix A, the key assumptions underlying the analysis of resource cost and the availability of renewable electricity sources are described in greater detail. In Appendix B, the resources that make up the "baseline" are described in greater detail.

II. SUMMARY OF RESULTS

Under the Prime Case studied, the annual net direct cost to New York electric ratepayers of the RPS is estimated to range from approximately $49,000 to $8 million in the first year of the program (2006), rising to a peak of approximately $107 to $146 million in the eighth year of the program (2013), the target year for reaching the 25% goal. [Note: All dollar values provided in this report are in real, 2003$, not nominal dollars, unless otherwise stated.] Under the Prime Case studied, the year 2003 net present value of the costs of the RPS from year 2006 through year 2013 ranges from $500 to $666 million. [Note: The expected long-term contracts would extend beyond the 2013 target year, but those costs have not been included in the NPV analysis.]

The projected incremental costs of the RPS program are significantly lower if the projections of fuel costs projections from the latest State Energy Plan, used in deriving the Prime Case, are modified to reflect current higher fuel costs. Adjusting the Prime Case for current higher fuel costs, the annual net direct cost to New York electric ratepayers of the RPS is estimated to range from approximately -$8.5 million to -$361,000 in the first year of the program (2006), rising to a peak of approximately $49 to $74 million in the fourth year of the program (2009), and then falling off to approximately -$39 million to +$646,000 in the eighth year of the program (2013). Adjusting the Prime Case for current higher fuel costs, the year 2003 net present value of the costs of the RPS from year 2006 through year 2013 ranges from $54 to $220 million.

Comparing current bills to year 2013 bills with the full cumulative impact of the RPS incorporated, residential bill impacts range from -1.74% to +2.09%, commercial bill impacts range from -1.50% to +2.61%, and industrial bill impacts range from -2.97% to +4.18%. Although most ratepayers would experience modest bill increases due to RPS, some ratepayers may experience bill decreases as a result of RPS where the suppression effect on supply and capacity costs in their location exceeds the premium they paid to acquire the new renewable resources.

The purchase of electric energy derived from cleaner, renewable resources due to the RPS will result in the displacement of some existing and planned electric generation resources. As a result, air emissions will be reduced in New York State. Total annual nitrogen oxide (NO_x) emissions will be reduced by approximately 2,000 tons (5.22%); sulfur dioxide (SO_2) by 7,000 tons (6.04%); and carbon dioxide (CO_2) by 3,683,000 tons (7.43%) when the RPS reaches its target level in the year 2013. Similarly, the emission reductions in the New York metropolitan area, including Long Island, are slightly greater with a 7.20% reduction in NO_x, a 7.09% reduction in SO_2, and an 8.25% reduction in CO_2.

Implementation of the RPS is projected to displace about 9% of the electric energy derived from oil and gas resources. This will greater diversify New York's electric energy supply portfolio and will reduce the risk of wholesale oil and natural gas price spikes and supply interruptions thereby increasing the security of New York's electric energy supply.

The net direct costs to New York electric ratepayers presented in this report reflect the estimated difference between the cost of renewable power sources and alternative wholesale power and capacity market purchases, adjusted to reflect the estimated effect that the

introduction of new renewable resources will have on electricity supply and capacity market prices in New York. The estimated net costs have not been adjusted to reflect any monetary value associated with:

? Downward pressure that new renewable resources can be expected to put on prices for fossil fuels, particularly natural gas. To the extent that reduced gas consumption for electric generation produces any reductions in gas prices, electric and gas ratepayers in New York will benefit;

? Increased price stability that long term contracts with renewable resource generators will offer relative to future electricity market purchases at uncertain prices;

? Reduction of air emissions associated with the displacement of fossil-fuel sources of electric generation and the associated health benefits that may accrue.

III. METHODOLOGY

The basic methodology and modeling approach were developed by the Sustainable Energy Advantage, LLC/La Capra Associates team for use in similar analyses preformed in Massachusetts, California, Wisconsin and Rhode Island, as well as for a 2001 analysis of the implications of New York's Executive Order 111 renewable energy purchase requirements. Adaptations were made, where appropriate, to accommodate New York's particular situation and to mesh the model with concurrent use of the MAPS model.

Cost Premium for Renewable Generation - A supply curve was constructed based on the cost premium above energy market value necessary to bring renewable generation on-line.[1] This approach recognizes that most renewable generation resources will be "price-takers" to ensure dispatch in NYISO energy markets and will be dependent upon the trading of "renewable energy credits" or some other extra-market revenue stream to recover above-market costs. Premiums were estimated based on the assumption that RPS compliance would be accomplished through procurement of renewable resources under long-term "contract-for-differences" (often referred to as CFDs) that pay a variable premium to the generator based on the difference between a negotiated contract price and the actual value of the energy at the time of generation. For the sake of ease, the effect of changes in energy prices and therefore premium costs from year to year after the first year in which the contract was awarded was calculated in aggregate for each year's increment rather than resource by resource.

Annual Increments of Chosen Resources - The awarding of long-term contracts to supply each year's incremental increase in demand created by the RPS was simulated in a spreadsheet-based model that awards contracts to the lowest-priced available resources up to the intersection of the quantity demanded with a supply curve depicting available quantity and cost of eligible renewable supply by resource technology. In each subsequent year, an additional increment of supply was selected for another round of long-term CFDs. Each year was individually modeled for this analysis.

Prices Paid to Generators Under Long-Term Contracts – We have calculated the sum of the individual resource costs for all resources called upon to enter into contracts, the cost-based approach, to represent the lower bound of potential costs. To bound potentially higher costs using a market-clearing approach, we have also provided an alternative calculation of costs based on an assumption that all renewable resources selected each year would receive the renewable generation premium required by the market-clearing resource.

Aggregate Compliance Costs - Over time, annual compliance costs were calculated as the aggregate of the current year and each previous year's long-term procurement for the year adjusted for current energy values.

[1] The supply curve data described in Appendix A was prepared without the direct consideration of UCAP revenues that would be received by generators. Instead, such revenues were factored in independently in an appropriate manner.

Wholesale Price and Air Emissions Reductions – The MAPS production simulation model was used to estimate the generation units that would be displaced by adding RPS resources and to quantify the wholesale price and air emissions effects of such displacement. Modeling in MAPS was limited to three years: 2006, 2009 and 2013. Intermediate year values were estimated by interpolation between the values calculated for these three years. Wholesale price effects were discounted to account for pre-existing long-term "hedge" contracts entered into by New York utilities & public authorities.

UCAP Revenues – Unforced capacity (UCAP) revenues were calculated for the years 2006, 2009 and 2013 using the current "demand curve" methodology. Intermediate year values were estimated by interpolation. UCAP revenues paid to renewable generators were limited by a 10% capacity factor for intermittent wind resources. Statewide UCAP cost changes were discounted to account for pre-existing long-term "hedge" contracts entered into by New York utilities & public authorities.

Net Ratepayer Bill Impacts – Bill impacts by customer class for each utility were estimated using a spreadsheet approach. Bill impact estimates were made for the years 2006, 2009 and 2013.

IV. KEY ASSUMPTIONS

A. Eligibility

This analysis is based on *preliminary* eligibility assumptions made by DPS Staff. These eligibility assumptions may not accurately reflect the Commission's final RPS design. In constructing the supply curve, the following new renewable resources were assumed to be eligible: wind; hydroelectric (consisting of *new* low-impact hydro, i.e. <30 MW, run-of-river, no new storage impoundment, and the incremental production associated with any upgrades to existing facilities so long as no new impoundments are created); biomass (including co-firing at coal plants, as well as other technologies using eligible fuels; electricity generated from landfill methane and manure digesters; solar; geothermal; ocean (e.g. tidal, wave); and fuel cells using any fuel. Waste-to-energy will be treated in a separate Volume II analysis of the sensitivity of the study to a regime where waste-to-energy technologies would be considered eligible for RPS compliance.

B. Tiers

Two independent supply curves were developed for the study. The first is designated the "Incremental" or “Main Tier” and is comprised of generators that will compete head-to-head for RPS demand and are expected to sell their output into the bulk wholesale market (and which are expected to earn wholesale commodity market revenue). The second is designated the “SBC-like Tier” and is comprised of generators expected to be installed by end-users – "customer-sited resources" (whose commodity value will be a function of the displaced retail rate). Resources in this latter tier may contribute to meeting RPS demand to the extent funds are made available to pay for premiums under programs similar, but in addition to, programs already funded by the system benefits charge (SBC).

C. Market Structure

We assumed the awarding of long-term contracts to supply each year's incremental increase in demand created by the RPS. Contracts were assumed to be awarded to the lowest-priced available resources up to the intersection of the quantity demanded with a supply curve depicting available quantity and cost of eligible renewable supply by resource technology. Costs were calculated using both a cost-based approach, to represent the lower bound of potential costs, and a market-clearing approach, to represent the upper bound of potential costs. In each subsequent year, an additional increment of supply was selected for another round of long-term contracts.

D. Schedule of Targets

We assumed that the first increment of RPS compliance would commence in year 2006. Thereafter, the increment would ramp up to reach the 25% level by year 2013. See Table 4D-1 below. The possible effects of attrition of small hydroelectric resources and expansion of green marketing programs were quantified in the baseline adjustments as described in Appendix B.

Table 4D-1
Incremental RPS Targets

Year	RPS Percentages
2006	0.58%
2007	1.16%
2008	1.75%
2009	2.33%
2010	2.91%
2011	3.49%
2012	4.08%
2013	4.66%

E. Wholesale Market Prices

The MAPS production simulation model was used to estimate the generation units that would be displaced by adding RPS resources and to quantify the wholesale price and air emissions effects of such displacement. The database used to run the model is based on the latest New York State Energy Plan. Unforced capacity (UCAP) revenues were calculated using the current "demand curve" methodology. Supply and UCAP cost changes were discounted to account for pre-existing long-term "hedge" contracts entered into by New York utilities and public authorities.

F. Supply Curve

The supply curves derived for this study contain resources and technologies that are expected to be major contributors to meeting the New York RPS. Appendix A provides a detailed description of the costs and characteristics of the renewable resources on the supply curves. We note that the supply curve is both broad and flat in shape. Any reordering of the resources due to differences between projected and actual costs or quantities of any particular resource would likely result in little overall change because replacement by the next highest resource would not be a substantial deviation.

G. Price Zones

For purposes of efficiency and transparency of the analysis, we aggregated the 11 NYISO zones into three “megazones” that capture the vast majority of market price differentials across the state, based on an analysis of zonal market prices:

- Zone 1 = NYISO zones A, B, C, D and E
- Zone 2 = NYISO zones F, G, H and I
- Zone 3 = NYISO zones J and K.

Within each megazone, prices have tended to be very similar, and transmission constraints are minimal relative to the constraints between megazones.

H. Treatment of Other Renewable Resource Demands

We have added to the RPS requirements additional demands for incremental New York renewable resources. These supplemental demands were assumed to seek resources from the same pool of resources used to meet the New York RPS, and it is assumed that the same mix of resources serve RPS and other demands, pro rata, in each year. Other demands for resources in New York were considered as follows:

- Executive Order 111 demands in excess of incremental RPS targets;

- New England RPS demands met by New York resources (assumed roughly 25% of New England RPS demands for new renewable resources would be met by resources available in general to the New York market.

We have not factored into this analysis competing demands for new renewable resources in Quebec, Ontario or PJM directly, as none are expected to be major importers of New York resources. However, demands for renewable resources in each of these regions will tend to compete for some of the resources located in those regions.

- PJM: The modest New Jersey RPS will compete for some of the PJM resources otherwise available to New York. To address this, in part, we have not modeled any landfill gas resources in PJM as available to New York. So far, most of the NJ RPS demand has been met by PJM landfill gas, and we expect this trend to continue. Furthermore, there appears to be potential for more wind and biomass co-firing in PJM than modeled as available to meet the New York RPS, but even so, we have reduced the assumed wind power available from PJM from Cost Study I to account for potential for additional RPS demands in the PJM area.

- Hydro Quebec's retail arm has established a program to procure 1000 MW of wind over the next ten years. While this demand would compete head-to-head with wind exports to New York, our modeling has not resulted in Quebec wind being called upon to meet New York RPS demand, and therefore ignoring this source of demand has not affected our analysis.

- Ontario has recently announced an intention to implement an RPS of its own. This plan would require that future legislation be passed to implement the RPS. We have ignored this potential demand for purposes of this preliminary analysis. If implemented, an Ontario RPS would likely compete for resources against exports to New York. As Ontario resources were projected to be called upon to meet New York RPS demand in this analysis, passage of an Ontario RPS would be expected to reduce availability of low-cost Ontario resources to New York, thereby raising slightly the projected compliance cost.

I. Additional Context

- The SEP wholesale electricity price forecast is somewhat low based on recent spot market and forward prices. Higher LBMPs associated with the current market outlook would lower the renewable premium.

- The wholesale electricity price forecast used in this analysis shows less of a price premium for Zones 3 and 2 (relative to Zone 1) than may have been reflected in historical spot and forward prices. To the extent that this is the case, resources added in Zones 1 and 2 will tend to be less costly than shown in our analysis.

- The actual cost of the RPS could depend to a large degree on its design, including auction approach, and the degree to which a cost-based approach is implemented rather than a market clearing approach.

- Our analysis assumes that renewable projects will be offered at prices that are sufficient to attract capital. We do not, however, assume any strategic bidding or exercise of market power. To the extent that these happen, actual costs could be higher. Market design and monitoring will therefore be important.

- We ignored the potential for funds from the SBC program to "buy down" the price of renewable projects. To the extent that this happens, actual ratepayer costs of the RPS will tend to be lower than shown here.

- While we generally addressed potential reductions in capital costs and increases in resource potential over time due to technological improvement, we generally ignored potential improvements in capacity factors. For some resources this will tend to overstate costs of RPS compliance. We also did not choose to model all potential resources eligible that *could* become available. For instance, advances in wave-power technology could introduce additional resources into the cost curve and further reduce costs.

J. Other Effects

This study has estimated direct power cost premiums that New York electricity customers would pay in accordance with procuring substantial new renewable power sources, along with the effect that new renewable resources would have on electricity supply and capacity market costs. The acquisition of new renewable resources on the scale anticipated in this study could have other effects, including:

- The introduction of large wind resources could cause some increase in the amount of regulation service required by the NYISO and (in the long term) the state's capacity reserve requirement.

- The displacement of fossil fuel-fired generation (primarily natural gas and oil) can be expected to put downward pressure on market prices for those fuels in the region.

- The analysis described here is a static, single scenario analysis that does not address the range of potential outcomes for electricity market prices and fossil fuel prices. It therefore does not capture the hedging effect that renewable resources procured for the RPS will have on New York's retail electric rates.

We have not quantified these offsetting effects, which may affect the ultimate cost to New York consumers of RPS compliance.

SECTION V-A INCREMENTAL RPS TARGETS

To determine the target level of renewable resources needed to reach the 25% level by year 2013, we began with the latest New York State Energy Plan (SEP) forecast of electricity sales in New York State. Next, we assumed a "baseline" level of renewable resources developed collaboratively with the parties to Case 03-E-0188, updated to actual Calendar Year 2002 data, and adjusted to reflect some attrition of existing small hydropower resources and some additions due to recent NYPA hydropower expansion projects. In addition, we assumed that concurrent implementation of Executive Order 111 and new "green marketing" programs would be adding to the baseline even in the absence of an RPS. See Appendix B for a more complete description of the changes in the baseline. Finally, we assumed that the RPS compliance requirements would commence in year 2006 and ramp up in equal percentage increments to the full 25% requirement in 2013. From these assumptions, simple mathematical calculations produce the incremental number of MWh's of renewable resources needed to meet the targets. For this analysis, we further separated the incremental MWh's into a proposed SBC-Like Tier (1% of the necessary incremental MWhs) and an Incremental or Main Tier. The result of our analysis is that an incremental 117,936 MWh's in the SBC-Like Tier and 11,675,660 MWh's in the Incremental/Main Tier will be necessary to achieve the 25% RPS in 2013. See Table 5A-1 below:

Table 5A-1
Calculation of RPS Targets (MWh's)

Year	SEP Forecast	Baseline	EO 111	Green Marketing	Increment Target	Total Renewables	Renewables Percentage	Incremental Percentage
2003	160,480,000	32,648,035	0	0	0	32,648,035	20.34%	
2004	162,844,000	32,834,662	0	0	0	32,834,662	20.16%	
2005	165,280,000	33,021,289	251,065	347,985	0	33,620,339	20.34%	
2006	167,490,000	33,207,916	286,385	347,985	1,202,925	35,045,212	20.92%	0.58%
2007	169,977,000	33,205,511	321,722	347,985	2,680,178	36,555,395	21.51%	1.16%
2008	172,404,000	33,203,105	357,075	347,985	4,173,125	38,081,290	22.09%	1.75%
2009	174,658,000	33,200,699	392,444	347,985	5,655,102	39,596,230	22.67%	2.33%
2010	176,910,000	33,198,294	427,830	347,985	7,162,848	41,136,956	23.25%	2.91%
2011	179,031,000	33,195,888	413,250	347,985	8,715,562	42,672,685	23.84%	3.49%
2012	180,907,000	33,193,482	398,671	347,985	10,233,155	44,173,293	24.42%	4.08%
2013	182,866,999	33,191,076	384,092	347,985	11,793,596	45,716,750	25.00%	4.66%

SECTION V-B QUANTITIES OF RENEWABLES DEVELOPED

Table 5B-1 below displays a breakdown of the renewable resources that we estimate would be reached in New York due to combined demand from the NY RPS Incremental or Main Tier, NY Executive Order 111 State Agency needs, and excess New England RPS demand. The share allocated pro rata to the NY RPS Incremental Tier demand is 11,675,660 MWh's. Table 5B-2 below displays a breakdown of the renewable resources by resource "block" (the derivation of which can be found in Appendix A) that we estimate would be obtained in New York due to demand from the NY RPS SBC-Like Tier.

Table 5B-1
Quantity of Renewable Resources Reached Through 2013

ENERGY SOURCE BLOCK	Location	Market Index	MWs Reached	MWHs Reached
Biomass Co-firing w/Coal NY-z1 b3	NY Zone 1	NY Zone 1	96.23	463,638
Hydro Upgrades Ontario	Ontario	NY Zone 1	800.00	3,000,000
Hydro Upgrades Quebec	Quebec	NY Zone 1	300.00	1,182,600
Wind Clusters NY-z1b2	NY Zone 1	NY Zone 1	150.00	433,620
Wind Farms PJM b1	PJM	NY Zone 1	250.00	722,700
Biomass Co-firing w/Coal NY-z1 b2	NY Zone 1	NY Zone 1	63.00	386,316
Wind Clusters NY-z3b2	NY Zone 3	NY Zone 3	15.00	43,362
Wind Farms NY-z1b3	NY Zone 1	NY Zone 1	1400.00	3,556,560
Landfill Gas IC Engines NY z3	NY Zone 3	NY Zone 3	3.18	26,505
Wind Clusters NY-z1b1	NY Zone 1	NY Zone 1	20.00	64,824
Wind Farms NY-z2b3	NY Zone 2	NY Zone 2	50.00	127,020
Wind Farms NY-z1b2	NY Zone 1	NY Zone 1	450.00	1,300,860
Biomass Co-firing w/Coal NY-z2	NY Zone 2	NY Zone 2	56.00	294,336
Wind Farms NY-z2b2	NY Zone 2	NY Zone 2	50.00	144,540
Wind Farms NY-z1b1	NY Zone 1	NY Zone 1	50.00	162,060
Biomass Co-firing w/Coal NY-z1 b1	NY Zone 1	NY Zone 1	38.00	233,016
Landfill Gas IC Engines NY z1	NY Zone 1	NY Zone 1	88.15	733,577
Landfill Gas IC Engines NY z2	NY Zone 2	NY Zone 2	25.73	214,117
Eligible Hydro Maintenance NY z1	NY Zone 1	NY Zone 1	41.53	127,333
		TOTALS	3,946.82	13,216,984
		NY RPS	3,486.56	11,675,660

Table 5B-2
Quantity of SBC-Like Tier Renewable Resources Through 2013

	MWh's	MW's
Solar PV	10,479	7.97
Wind Small	1,361	0.78
Fuel Cells	106,097	13.46
Totals	117,936	22.21

SECTION V-C COST OF RENEWABLES DEVELOPED

Using the SEP fuel price forecast, Tables 5C-1 and 5C-2 below display a breakdown of the direct cost premiums in each program year that we estimate would be necessary to achieve the RPS. Tables 5C-3 and 5C-4 below provides the cumulative total of the annual cost premiums.

Table 5C-1
Annual Cost Premiums to Achieve the RPS – Cost Based Approach (2003$)

	2006	2007	2008	2009
RPS Main Tier	$9,966,781	$32,215,194	$59,840,101	$88,463,138
RPS SBC-Like Tier	$10,716,706	$10,716,706	$10,716,706	$7,726,219
Total Cost to Achieve RPS	$20,683,488	$42,931,900	$70,556,807	$96,189,357

	2010	2011	2012	2013
RPS Main Tier	$115,152,205	$144,295,304	$165,946,121	$196,108,432
RPS SBC-Like Tier	$7,726,219	$7,726,219	$4,735,731	$4,735,731
Total Cost to Achieve RPS	$122,878,424	$152,021,523	$170,681,852	$200,844,163

Table 5C-2
Annual Cost Premiums to Achieve the RPS – Market Clearing Approach (2003$)

	2006	2007	2008	2009
RPS Main Tier	$18,141,342	$50,979,750	$81,587,730	$113,491,957
RPS SBC-Like Tier	$10,716,706	$10,716,706	$10,716,706	$7,726,219
Total Cost to Achieve RPS	$28,858,048	$61,696,457	$92,304,436	$121,218,176

	2010	2011	2012	2013
RPS Main Tier	$142,739,150	$175,377,202	$199,720,627	$235,350,207
RPS SBC-Like Tier	$7,726,219	$7,726,219	$4,735,731	$4,735,731
Total Cost to Achieve RPS	$150,465,369	$183,103,421	$204,456,358	$240,085,939

Table 5C-3
Cumulative Cost Premiums to Achieve the RPS – Cost Based Approach (2003$)

	2006-2013
RPS Main Tier	$811,987,276
RPS SBC-Like Tier	$64,800,238
Total Cost to Achieve RPS	$876,787,514

Table 5C-4

Cumulative Cost Premiums to Achieve the RPS – Market Clearing Approach (2003$)

	2006-2013
RPS Main Tier	$1,017,387,965
RPS SBC-Like Tier	$64,800,238
Total Cost to Achieve RPS	$1,082,188,203

SECTION V-D IMPACT ON ELECTRICITY MARKET PRICES

The MAPS modeling results show that implementation of the RPS will result in significant reductions in statewide wholesale electricity prices due to the market effects of increased electric energy supply resources. These results represent the net effects of offsetting influences. First, additions of large quantities of renewable resources, many of which will have zero fuel cost and most of which will be price takers, will suppress energy market clearing prices, lowering the cost of electricity for all consumers. However, as most renewable resources are not displaceable and some are intermittent, a different mix of resources may need to be in place for reliability purposes, such as a greater proportion of combustion turbine capacity. Thus, moderate changes to non-renewable capacity expansion mix are reflected in the MAPS runs to address the proportionately higher operating reserve requirements of a high-renewable resources mix. These additional costs partially offset the price suppression effects of renewable resources on energy market prices. The net effect of these influences is shown in the table below as wholesale energy price reductions. In addition, a high proportion of intermittent renewable resources feeding the grid are expected to require some additional transmission system investments. We have attempted to capture this factor directly by adding to the capital cost of wind power additional costs for upstream transmission system improvements. Finally, due to long-term fixed-price energy contracts ("hedging" contracts) already entered into by New York utilities and public authorities, a large proportion of the potential price suppression effects of renewable resources on energy market prices cannot be realized. The figures given below for wholesale energy cost reductions have been discounted to account for the "hedge" effect. See Table 5D-1 below:

Table 5D-1

Annual Wholesale Energy Cost Reductions Due to RPS – Statewide Totals (2003$)

Year	Reductions
2006	-$4,929,811
2009	-$9,450,521
2013	-$90,697,166

SECTION V-E CAPACITY COSTS

To meet a certain level of reliability, energy suppliers must ensure that they have enough generating capacity (Installed Capacity or "ICAP") available to serve their customers' peak demand plus a reserve margin. Every customer on the system adds to an energy supplier's ICAP obligation. Suppliers can acquire ICAP through a bilateral contract with a generator, through the NYISO summer or winter capability auctions, or through the NYISO deficiency auction.

The development of large amounts of RPS generation is likely to impact capacity and energy prices to the extent that either existing generation would retire or new generation may not be built and therefore should not result in an excessive quantity of capacity.

The additional RPS generation may also have an effect on the total installed capacity requirement since RPS supplies from intermittent generation may tend to increase the current 18% reserve requirement. A change in the required installed reserve margin will affect the total amount of ICAP required in the state. The New York State Reliability Council (NYSRC) establishes reliability rules for use by the NYISO to maintain the integrity and reliability of the power system. In doing so, the NYSRC considers such factors as transmission capabilities, load forecast uncertainty, installed capacity conditions in neighboring systems, emergency assistance available from neighbors, projected availability rates of generating units in New York, and NYISO emergency operating procedures when determining the appropriate New York State reserve margin. The NYSRC and the NYISO are currently studying and evaluating the effects of intermittent generating resources on system operation and reliability. The NYISO has said that it is prepared to take whatever steps necessary to secure the safety and reliability of the New York State system if and when the intermittent resources are added in significant amounts in the future.

<u>Assumptions made to account for capacity revenue to renewable resources</u>

Unforced Capacity (UCAP) charges are translated from the need to provide required levels of ICAP. UCAP revenues are accounted for in two ways in the calculation of net costs. It was assumed that each renewable energy source would receive a UCAP payment for an amount of capacity equal to its maximum capacity times its capacity factor, except that we limited the capacity factor of intermittent wind resources to 10% due to their limited availability on-peak. UCAP prices were established by applying the current "demand curve" to projected amounts of capacity in years 2006, 2009 and 2013. In addition, our analysis shows that implementation of the RPS will result in changes in statewide UCAP prices due to the market effects of increased electric energy capacity resources. Due to long-term fixed-price capacity contracts ("hedging" contracts), a large proportion of the potential effects of renewable resources on UCAP market prices cannot be realized. The figures given below for changes in UCAP prices have been discounted to account for the "hedge" effect. See Tables 5E-1 and 5E-2 below:

Table 5E-1
UCAP Payments to Renewable Generators

2006	2007	2008	2009	2010	2011	2012	2013
$4,933,910	*$8,100,003*	*$11,266,095*	$14,432,187	*$20,161,585*	*$25,890,983*	*$31,620,381*	$37,349,779

Table 5E-2
Annual Capacity Cost Changes Due to RPS – Statewide Totals (2003$)

Year	Changes
2006	-$15,704,247
2009	+$16,009,356
2013	-$3,425,594

SECTION V-F ENERGY PRICE BILL IMPACTS

Comparing current bills to year 2013 bills, with the full cumulative impact of the RPS incorporated, residential bill impacts range from -1.74% to +2.09%, commercial bill impacts range from -1.50% to +2.61%, and industrial bill impacts range from -2.97% to +4.18%. Although most ratepayers would experience modest bill increases due to RPS, some ratepayers may experience bill decreases as a result of RPS where the suppression effect on supply and capacity costs in their location exceeds the premium they paid to acquire the new renewable resources. In the context of the high volatility in energy commodity prices in recent years, the magnitude of such increases is slight. All costs were allocated *pro rata* based on energy usage. The estimated costs were translated into expected bill impacts by customer class for each utility using a spreadsheet approach. This bill impact analysis is only meant to be illustrative of the magnitude of impacts. It is not intended to constitute a rate design proposal, or to address issues of bill textual content or disclosure. See Tables 5F-1, 5F-2 and 5F-3 below:

Table 5F-1
Comparison of Net Present Value in Year 2003 (2003$)

	Prime Case Cost Based Approach	Prime Case Cost Based Approach With Updated Fuel Prices	Prime Case Market Clearing Approach	Prime Case Market Clearing Approach With Updated Fuel Prices
Net Present Value	$500,263,508	$53,689,463	$666,189,325	$219,615,307

Table 5F-2
Range of Bill Impact – Current Bills to Year 2013 (2003$)

	Prime Case Cost Based Approach	Prime Case Cost Based Approach With Updated Fuel Prices	Prime Case Market Clearing Approach	Prime Case Market Clearing Approach With Updated Fuel Prices
Residential	-0.40% to +1.76%	-1.74% to +1.25%	-0.19% to +2.09%	-1.52% to +1.58%
Commercial	-0.35% to +2.19%	-1.50% to +1.55%	-0.16% to +2.59%	-1.31% to +1.97%
Industrial	-0.69% to +3.51%	-2.97% to +2.49%	-0.33% to +4.18%	-2.61% to +3.15%

Table 5F-3

Range of Bill Impact by Utility – Current Bills to Years 2006, 2009 & 2013 (2003$)

PRIME CASE Cost Based Approach		2006		2009		2013
CENTRAL HUDSON						
Residential Bill Impact Range		-0.08% to -0.12%		+0.96% to +1.52%		+1.11% to +1.76%
Commercial Bill Impact Range		-0.11% to -0.15%		+1.37% to +1.89%		+1.59% to +2.19%
Industrial Bill Impact Range		-0.16% to -0.24%		+2.03% to +3.02%		+2.36% to +3.51%
CON EDISON						
Residential Bill Impact Range		+0.02% to +0.03%		+0.37% to +0.64%		+0.56% to +0.96%
Commercial Bill Impact Range		+0.02% to +0.03%		+0.38% to +0.51%		+0.57% to +0.76%
Industrial Bill Impact Range		+0.03%		+0.51% to +0.63%		+0.76% to +0.95%
NYSEG						
Residential Bill Impact Range		-0.03% to -0.04%		+0.27% to +0.39%		+0.15% to +0.22%
Commercial Bill Impact Range		-0.03% to -0.04%		+0.28% to +0.38%		-0.16% to -0.22%
Industrial Bill Impact Range		-0.05% to-0.06%		+0.50% to +0.59%		-0.28% to -0.34%
NIAGARA MOHAWK						
Residential Bill Impact Range		-0.06% to -0.09%		+0.23% to +0.36%		-0.25% to -0.40%
Commercial Bill Impact Range		-0.06% to -0.08%		+0.26% to +0.31%		-0.29% to -0.35%
Industrial Bill Impact Range		-0.08% to -0.16%		+0.30% to +0.62%		-0.34% to -0.69%
O&R						
Residential Bill Impact Range		-0.19% to -0.35%		+0.87% to +1.56%		+0.82% to +1.47%
Commercial Bill Impact Range		-0.21% to -0.37%		+0.96% to +1.66%		+0.90% to +1.56%
Industrial Bill Impact Range		-0.35% to -0.45%		+1.57% to +2.03%		+1.48% to +1.91%
RG&E						
Residential Bill Impact Range		+0.01%		+0.31% to +0.57%		+0.13% to +0.24%
Commercial Bill Impact Range		+0.01%		+0.30% to +0.49%		+0.13% to +0.21%
Industrial Bill Impact Range		+0.01% to +0.02%		+0.49% to +0.74%		+0.20% to +0.31%

Note: The above table illustrates the Prime Case, cost based approach only. See the bill impact spreadsheets that are part of the work-papers for this report for details on the other sensitivities.

SECTION V-G GENERATION DISPLACED BY RENEWABLES

The MAPS modeling results show that implementation of the RPS will result in displaced generation and underlying fuel usage due to the market effects of increased electric energy supply resources. See Table 5G-1 below:

Table 5G-1
Fuel Usage Changes – Year 2013

FUEL TYPE	UNITS	VOLUME	GENERATION (MWh)
Coal	TONS	(314,330)	(708,745)
Oil	BBL	(1,079,484)	(608,404)
Gas	MCF	(38,759,301)	(5,437,355)
Nuclear	MBTU	(0)	(0)
Wood	TONS	(24,615)	(16,844)
Refuse	TONS	(702)	(454)
Landfill Gas	MBTU	13,184,794	972,500
		TOTAL GENERATION:	(5,799,302)

SECTION V-H AIR EMISSIONS

The MAPS modeling results show that implementation of the RPS would result in reductions in statewide air emissions (see Table 5H-1 below). This result is expected because the dispatch of new renewable electric generation facilities will mean that fossil-fired generating plants will produce less electricity, resulting in a reduction of total emissions. The net result of adding renewable generation by the year 2013, total nitrogen oxide (NO_x) emission in New York State are projected to be reduced by approximately 2,000 tons (5.22%); sulfur dioxide ($S0_2$) by 7,000 tons (6.04%); and carbon dioxide ($C0_2$) by 3,683,000 tons (7.43%). The emission reductions in the New York metropolitan area, including Long Island, are slightly greater with a 7.2% reduction in NO_x; a 7.09% reduction in SO_2 and an 8.25% reduction in CO_2. A reduction in these criteria emissions is an important environmental benefit because of their contribution to acid deposition (acid rain), ozone pollution (smog) and global warming and their resultant health and welfare affects on the public and the environment.

Table 5H-1

Air Emissions Reductions with RPS (x 1,000 tons)

	Emission	Base Case	RPS Case	Net Change	Percentage Change
2006					
Total Statewide Emissions	**NO_x**	46	46	0	0.12%
	SO_2	118	117	(1)	-0.84%
	CO_2	45,491	45,080	(411)	-0.90%
Total NYC/Long Island Emissions	**NO_x**	22	22	(0)	-1.21%
	SO_2	15	15	(1)	-3.34%
	CO_2	25,022	24,793	(229)	-0.92%
2009					
	Emission	**Base Case**	**RPS Case**	**Net Change**	**Percentage Change**
Total Statewide Emissions	**NO_x**	39	39	0	0.01%
	SO_2	115	113	(2)	-2.01%
	CO_2	46,644	44,864	(1,780)	-3.82%
Total NYC/Long Island Emissions	**NO_x**	16	16	(0)	-0.32%
	SO_2	11	11	(0)	-1.03%
	CO_2	26,919	25,673	(1,246)	-4.63%
2013					
	Emission	**Base Case**	**RPS Case**	**Net Change**	**Percentage Change**
Total Statewide Emissions	**NO_x**	40	38	(2)	-5.22%
	SO_2	121	114	(7)	-6.04%
	CO_2	49,541	45,858	(3,683)	-7.43%
Total NYC/Long Island Emissions	**NO_x**	15	14	(1)	-7.20%
	SO_2	11	10	(1)	-7.09%
	CO_2	29,243	26,829	(2,414)	-8.25%

SECTION V-I ENERGY SECURITY

The addition of new renewable electricity supplies due to RPS demand will result in the displacement of existing generation supplies, including those that rely on oil and natural gas as fuel. In that regard, the changes in generation resources due to the RPS program as estimated by the MAPS production simulation model have been examined. In 2013, the peak year, the RPS will result in the displacement of approximately 6,046,000 MWh's of electric energy derived from oil and gas resources. That change, creating greater diversity in New York's electric energy supply portfolio, will reduce by 9% the exposure to wholesale oil and natural gas price spikes and supply interruptions, thereby increasing the security of New York's electric energy supply. See Tables 5I-1 and 5I-2 below:

Table 5I-1
Displacement of Generation Resources (GWh's)

	Base Case	Renewables Case	Difference
Oil	1,682	1,073	608
Gas	66,903	61,466	5,437
All Other	59,011	59,151	(140)
Totals	127,596	121,690	5,906

Table 5I-2
Reduction in Fuel Price & Supply Risk (GWh's)

	Base Case	Renewables Case	Difference
Oil & Gas	68,585	62,539	6,046
Percent	100%	91%	9%

SECTION V-J IMPACT ON NATURAL GAS PRICES

Renewable energy development expected under the RPS would offset demand for natural gas at gas-fired power plants serving the state. In particular, our analysis shows a reduction in natural gas demand under the RPS of 38,759,301 MCF in 2013, equating to a reduction of 5,437,355 MWhs from electric generators using natural gas as the fuel. While not quantified specifically in this report, a secondary benefit of the RPS is likely to be a suppression of natural gas prices in the state.

Economic theory predicts that a reduction in natural gas demand, like that caused by an RPS, will lead to a subsequent reduction in the price of natural gas. The amount of that price reduction will depend on the shape of the supply curve for natural gas, or in other words, the relationship between the level of natural gas demand and the price of gas supply. According to an ongoing literature review by Lawrence Berkeley National Laboratory, little empirical economic research has explored this relationship. Only one recent paper, Krichene (2002), has been identified that attempts to quantify the impact of changes in natural gas demand on the price of gas supply.[2] Krichene's research suggests that a 1% reduction in natural gas demand would lead to a 1.25% reduction in the wellhead price of natural gas. We cite this only as illustrative that there is such a price effect.

The above evidence suggests that the RPS will not only have the effect of reducing natural gas consumption, but as a result of that reduced demand, there will be downward pressure on natural gas prices in the state, providing benefits broadly to consumers in the form of both lower natural gas and electricity bills. It deserves reiteration, however, that this report does not attempt to specifically quantify the level of this expected natural gas price response. Because New York's natural gas demand represents only a fraction of total U.S. demand, it is unclear to what degree a reduction in gas demand in the state will differentially benefit New York's consumers relative to gas consumers throughout the entire country. Accordingly, further research would be necessary to better assess the likely magnitude of the impact of New York's RPS on natural gas prices in the state.

[2] Krichene, N. 2002. "World crude oil and natural gas: a demand and supply model." Energy Economics. 24, 557-576.

SECTION V-K ECONOMIC DEVELOPMENT BENEFITS

Implementation of the RPS is expected to provide economic development benefits to New York. Incentives to spur further development of emerging technologies and construction and operation of generating facilities should result in the creation of both direct and indirect jobs, purchases of local products and services, which add revenues to local economies, and new and increased tax payments by employees and facilities.

Employment

New renewable energy projects have the potential to have a direct impact on employment in several ways. First, during construction, a workforce is gathered to prepare sites and construct the facility and other components such as transmission lines and substations. The impact of this workforce depends on its availability in the area or whether it is temporarily imported and the duration and scope of the project. Typically, once a project is built, the workforce consists of a smaller operations staff that might be provided by the existing workforce or, depending on the requirements, may come from outside the community.

There are also potential indirect employment impacts that result from construction of renewable energy resources. Any new workforce in a community – whether construction or operation – affects local retail, supply and service businesses. A new workforce in a rural, low population area could represent a substantial relative increase in secondary economic activity. Department of Labor statistics generally show that for every skilled industrial job created, an additional two retail jobs are created in an area.

A second potential indirect impact relates to the manufacture of renewable energy equipment. Manufacturing is generally a global activity but as the RPS incentive increases the demand for renewable energy in New York, it is plausible that manufacturers of the equipment and providers of ancillary services associated with that equipment would be attracted to sites in New York. Consequently, additional jobs will be created, which will benefit the local and state economies.

Tax Impacts

Traditionally, tax impacts/benefits would be determined by a project's value and the local taxing structure. In such a traditional circumstance, all that is needed is location, the project value and a tax rate in order to compute the tax benefit. Alternatively, many new commercial and industrial developments negotiate a tax schedule, known as a Payment In Lieu Of Taxes, or PILOT, agreement that usually provides a tax break in early years (to encourage the project to locate in the area) and a gradual (e.g., 10-15 years) ramp up to fully taxed status. The impact of traditional or PILOT taxation also depends on the size of the existing tax base; a project of modest taxable value added to a large tax base will have very little overall effect on local tax. In contrast, a large project in a rural area with a small tax base could add significantly to the local tax base.

Other Local Economy Impacts

To the extent renewable resources require lease or purchase of land from local owners, additional funds, which could find their way into the local economy, could stimulate other business. In rural areas, additional funds from lease agreements could supplement farm income,

provide smaller farms and businesses opportunities for diversifying sources of income, or be used for agricultural improvements and increase productivity.

Further, because the RPS is predicted to improve New York's air quality, it is reasonable to expect health improvements that in turn may result in greater worker productivity and reduced spending on health care throughout the area. Improved air quality would also make New York a more attractive place to which other types of businesses may chose to locate; thus adding to the workforce and benefiting the local and state economy.

SECTION V-L TRANSMISSION CONGESTION CONTRACTS (TCCs)

A Transmission Congestion Contract (TCC) is the right to collect or obligation to pay Congestion Rents between a specified point of injection (POI) and point of withdrawal (POW). TCCs are financial instruments that enable energy buyers and sellers to hedge fluctuations in the price of transmission. TCCs may be acquired by the conversion of grandfathered transmission rights, or by acquiring TCCs at a NYISO TCC auction ("TCC auction"). Once acquired, a TCC may be kept, traded, or released for sale at a TCC auction

The supply of TCCs is associated with the physical capability of the transmission system and therefore will not be increased or decreased with the additional RPS generation. The demand for TCCs though may increase with the additional RPS generation. For example, wind and solar RPS generation, due to its intermittent characteristics may cause more variability in the cost of transmission congestion. Such things as intermittence, capacity factor, distance from load, and coincidence with peak will affect transmission congestion prices from hour to hour. To hedge this variability in price, RPS generation owners or buyers in the bilateral market would seek TCCs to have a more certain transmission cost. RPS generation selling directly into the NYISO market would, on the other hand, not have any need for TCCs. The effect on TCC market prices due a change in demand has not been studied but could be done in the future. In general, additional RPS generation will tend to decrease energy prices at their location and thus increase the cost of transmission congestion from the RPS generation to load centers. This will tend to increase the value of TCCs between the RPS generation and load centers.

SECTION V-M ANCILLARY TRANSMISSION SERVICES

Transmission service is the right to move power across transmission facilities. There are, however, many "ancillary" services required to enable this movement of power while maintaining a reliable electrical system. The power needs to be dispatched. Voltage on the system needs to be controlled to enable the power flow. Reserves need to be maintained to ensure the power continues to flow even if there are failures on the system. System frequency needs to be maintained so that the system remains stable. Generators often depend on the capabilities of the transmission system to restart from blackout conditions. Some of these services can only be supplied by the system operator, the New York Independent System Operator (NYISO); others can be self-supplied. Some of the services are mandated to be purchased from the NYISO; others are optional. The following sub-sections describe the six ancillary services offered by the NYISO and how they are expected to apply to the renewable industry.[3]

Scheduling, System Control & Dispatch

The NYISO continually monitors the operations of the bulk electric transmission system, processes generator bid information and commits and dispatches resources to reliably meet load requirements. It also provides a planning function to ensure the electrical system is sufficient to serve New York's power needs in the future. In performing these functions it incurs capital and operational costs which include, but are not limited to those necessary to own and maintain buildings, extensive computer equipment and other facilities, as well as to employ a large and diverse technical and administrative staff. The NYISO recovers these costs, as well as its initial startup costs and regulatory fees through Schedule 1 of its Market Services Tariff (covering market services and control area services) and Open Access Transmission Tariff (covering transmission service). The current combined OATT and Market Service Tariff rate is $0.74/MWH.

Recently the NYISO was permitted to charge 15% of its cost of operations and FERC regulatory fees to suppliers (including renewable resources). How this will affect the Schedule 1 rates is currently being discussed within the NYISO's Billing and Accounting Working Group. Given that due to losses, there are more MWHs produced than consumed, there is a slightly larger base to spread the charge over. If the Working Group recommends a MWH charge, it would be expected that there would be a rate charged to generators of about $.11/MWH.

[3] It should be noted that the required supply of most ancillary services is dependent on the level of load that needs to be met; not on the amount of generation available on the system. Therefore, if a renewable resource meets the technical requirements to supply an ancillary service, it is merely replacing another unit that would have sold into the ancillary services market. Where there are sufficient renewable resources that meet the technical requirements (e.g. units with AGC for Regulation Service, units under ISO control for Reserve Service), there could be a sufficient increase in availability to apply downward pressure on clearing prices. Large, concentrated amounts of non-synchronous generation, such as wind-power, brings a new dynamic to the New York market. Given the myriad of issues related to these units that have not yet been resolved, it is difficult to provide any analysis as to the expected market impacts.

Voltage Support Services

Just as pressure is required to move water through a pipe, certain voltage levels need to be maintained throughout the entire transmission system to enable the power to flow from source to load. Voltage at each bus within the transmission system must be maintained within acceptable limits. The voltage level must be actively controlled as voltage changes constantly in response to flow levels. Such control is achieved by devices that produce or absorb reactive power (VARs). The NYISO pays suppliers of voltage support services and charges load-service entities (LSEs), direct transmission customers and wheel-through and export transactions for consumption of voltage support services. Voltage Support is an embedded, cost-based service that must be purchased from the NYISO[4] under Rate Schedule 2. LSEs, exports and wheel-throughs are charged at a current rate of $0.34/MWH. Suppliers are currently paid at an annual rate of $3,919/MVAR. To be eligible for voltage support payments, a generator has to have a functioning Automatic Voltage Regulator and demonstrate the unit's capacity through capability curves and testing. ICAP providers meeting service requirements receive payments for voltage support at all times. Generators without ICAP contracts receive payments only when the unit is online.

The design of voltage support services is based on a system where synchronous generators are the predominate type of unit connected to the system, and any renewable project that meets the requirements as a supplier of this service would automatically come under the tariff. Large wind farms, however, were not envisioned when this service was developed. Often, variable VAR controllers (passive for small farms and active for large farms) are required for the interconnection of wind farms. Requirements for voltage control at the point of interconnection for large wind farms and whether active VAR controllers will qualify the project as a VAR supplier are currently under review at the NYISO.

Black Start Service

Black Start Service is designed to restore electric system operation after a complete outage of facilities (i.e. blackout conditions). Generators which are capable of starting without an outside electric supply, and are available to participate in system restoration efforts, may offer Black Start Service to the NYISO. The ISO maintains a restoration plan which includes the key generators needed to participate in system restoration efforts. Generation units are selected based on their location in the grid, the unit's startup time, maximum power output and ramping capability.[5] All LSEs must purchase Black Start Service from the NYISO.

Black Start is an embedded, cost-based service provided under Rate Schedule 6. Generators included in the restoration plan receive payments based on their embedded capital costs of Black Start–related equipment, operating and maintenance expenses and training costs. LSEs pay a monthly Black Start charge on all transactions (in-state bilateral, LBMP market

[4] Entities can self-supply this service but they do so by bidding into the NYISO and being selected into the market. Self-suppliers are subject to the same performance criteria as all other suppliers and must supply adequate metering information. Payment for selected, self-supplied service is through offsets to payments due for all ancillary services.
[5] The transmission owners also maintain restoration plans for their local systems. Units providing local area black start capability are paid by the NYISO, which is reimbursed by LSEs within those transmission owner's areas.

purchases and imports) to supply load in the NYCA. The current charge is $15,181 multiplied by the LSEs load share of the total NYCA load. Any qualifying renewable generator can participate in supplying Black Start Service on the same basis as all other generators.

Regulation & Frequency Response

The amount of generation must equal the amount of load at all times. The majority of the generation is provided through the day-ahead energy market. The NYISO determines the appropriate dispatch for the projected load based on generators' bids and reliability criteria. A generator that is selected in either the day-ahead or hourly market receives a schedule indicating the output required from the generator every five minutes; the unit moves between these five minute set points by ramping output at six second intervals. However, given electricity must flow every time someone flips a light switch or brings an assembly line into operation, the amount of generation being supplied must change instantaneously as the load level moves up or down. The service required to enable this instantaneous and continuous change is Regulation & Frequency Response.

Generators with automatic generation control (AGC) capability can simultaneously provide bids for energy sales and regulation service. All units selected by the ISO for regulation receive the appropriate clearing price (day-ahead or hourly) for the amount of regulation capability supplied by the unit, times a factor based on its availability performance (i.e. better performance equals greater payments). In addition it receives payment for any additional energy produced as a result of it following its AGC signal.

The cost of supplying this ancillary service is paid by LSEs and generators that do not provide regulation service. The payment methodology can be found under Rate Schedule 3. Given that the charge for this service varies with the clearing price, a projection of cost to non-service supplying generation is not possible. Renewable resources can supply this service on the same basis as other generation sources.

It should be noted that Regulation & Frequency Response service was designed based on a system predominately supplied by synchronous generators. Wind machines can be subject to wind gusts that rapidly change the output of the units. Two issues result from this operation. The first is reliability. With small amounts of wind generation at scattered locations throughout the system, regulation service as designed can handle the rapid changes. However, if you have large amounts of such variable output or have it concentrated is a small area of the electrical system, synchronous generation in the local area may not be sufficient to handle the swings or the rapid, repeated swings could create instability on the system forcing synchronous generators to trip off-line. The NYISO is currently looking at this issue in the context of interconnecting large amounts of wind generation to the system. The second issue is that supplying regulation to wind machines was not part of the design of this ancillary service and may have to be revised for their inclusion.

Operating Reserves

In a perfect world, having sufficient generation to supply the peak loading of the system would be sufficient. However, while electricity moves at the speed of light, it moves over mechanical facilities made from materials that are subject to stresses and, at times, fail. Backup generation, therefore, is required to maintain a reliable supply of electricity. There are two types of generation reserves – installed capacity and operating capability. Installed capacity, or ICAP, is a seasonal concept designed to ensure there is sufficient generation available to serve peak load.[6] Operating capability is the amount of generation required to ensure there is sufficient power to supply real-time load and the reserve generation that is ready to replace generation that might trip off-line or cannot reach the load due to the loss of a transmission line. The reserve replacement generation is what is meant by Operating Reserves.

The Operating Reserve requirement is based on the largest, single contingency that can be experienced within the NYCA. The largest contingency is 1200 MWs and this is the amount that must be met by 10 minute reserves.[7] As a prudent measure, another 600 MWs (or 50% of the largest contingency) is put on 30 minute reserve to cover possible cascading outages or for failure of quick-start generation included in the 10 minute non-synchronous reserves.

Suppliers of Operating Reserves are paid an availability payment in exchange for the NYISO being able to reserve capacity on the supplier's generator, or a commitment that the supplier can interrupt an adequate amount of load. Additionally, all energy generated when reserve capacity is activated, is paid the real-time LBMP. To the extent that securing operating reserves on a ten minute reserve generator causes it to be dispatched at a level below what it normally would have been through the security constrained dispatch, the generator will also receive payment for its actual lost opportunity costs.

To participate in these markets, generators must be located within the NYCA, under ISO operational control, and capable of supplying the energy for a minimum of 20 minutes. Further, the energy associated with the scheduled spinning reserves can not be sold in any other market.[8] ICAP providers east of the Total East constraint must bid available capacity in the 10 minute non-synchronous reserve market. LSEs and exporting transmission customers pay for Operating Reserves based on their ratio share of the load on an hourly basis and billed monthly per Rate Schedule 5.

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[6] ICAP is supplied through a separate market administered by the NYISO and is not an ancillary service.

[7] When a contingency is experienced on the system, the power is replaced immediately by the generators operating at that time, both within the NYCA and in surrounding areas with each generator picking up a portion of the loss. Reliability rules dictate that within 10 minutes, all of the lost generation must be supplied reliably (i.e. within operating limits) from within the control area. To accomplish this within the time frame, half of the reserves need to already be on-line and spinning.

[8] Provision for suppliers outside of the NYCA and demand-resources to participate in these markets is under development.

Renewable generators may participate in supplying operating reserves on the same basis as all other generation. As a reference guide, the *average* clearing prices for 2002 were:

10 Minute Spinning Reserves – East $3.03
- West $2.82

10 Minute Non-Synchronous Reserves – East $1.51
- West $1.27

30 Minute Reserves - $1.13

Note that payments are based on hourly clearing prices and will vary significantly. As such, a future generator should not project revenues based on these sample numbers.

Energy Imbalance

While load forecasting methodologies are very sophisticated, forecast loads will be different from the actual experienced load. Further, generators, at times, over or under generate from what is specified in their day-ahead schedule in spite of best intentions. Energy Imbalance service is provided to cover the mismatch between what is scheduled in the day-ahead market and what is experienced in real-time.

For NYISO customers that take service under Market Services Tariff, energy imbalance service is considered to be supplied through the real-time energy market and settled at real-time LBMP prices. Renewable resources selling into the NYISO's energy market are subject to such settlements.

VI. CONCLUSION

A Renewable Portfolio Standard (RPS) designed to increase the renewable energy share of New York's electricity supply to 25% can be implemented in New York State without significant direct net bill impacts on electric ratepayers. The RPS will also provide direct reductions in the emission in New York State of nitrogen oxide (NO_x), sulfur dioxide (SO_2), and carbon dioxide (CO_2), particularly in the New York City metropolitan area, including Long Island. The RPS will also increase diversity in the resources used to generate the electricity provided to New York consumers and decrease the risk to New York consumers of price spikes and supply interruptions due to reliance on foreign sources of fossil fuels. Finally, the RPS will also result in indirect economic development, environmental quality and public health benefits.