Comparative Evaluation of Alternating Current Transmission Upgrade Alternatives

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New York State Department of Public Service
Trial Staff Final Report

Cases 12-T-0502, 13-E-0488, 13-T-0454, 13-T-0455,
13-T-0456, 13-M-0457, and 13-T-0461

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Table of Contents

GLOSSARY OF SUBSTATION & SWITCHYARD ABBREVIATIONS

Substation/Switchyard	*Abbreviation*
Churchtown	CH
Coopers Corners	CC
CPV Tap	CPV
East Fishkill	EF
Edic	ED
Fraser	FR
Gilboa	G
Greenbush	GB
Hurley Avenue	HA
Knickerbocker	KN
Leeds	LD
Marcy	M
New Scotland	NS
Oakdale	O
Orchard Hill	OH
Pleasant Valley	PV
Princetown	PR
Rock Tavern	RT
Roseton	RS
Rotterdam	R

OTHER ACRONYMS

ADT	Average Daily Traffic
AFUDC	Allowance for Funds Used During Construction
GEIS	Generic Environmental Impact Statement
RPS	Renewable Portfolio Standard
REC	Renewable Energy Credit
UPNY	Upstate New York
LBMP	Locational Based Marginal Prices
LCR	Locational Capacity Requirements
IRM	Installed Reserved Margin
RSSA	Reliability Support Services Agreements
PCA	Production Cost Savings
MAPS	Multi Area Production Simulation Software
TCC	Transmission Congestion Contracts
NYPA	New York Power Authority
SASS	Scenic Area Statewide Significance
NYISO	New York Independent System Operator
CARIS	Congestion Assessment and Resource Integration Study
EIPC	Eastern Interconnection Planning Collaborative
JCSP	Joint Coordinated System Plan
DOE	United States Department of Energy
FERC	Federal Energy Regulatory Commission
Ag&Mkts	New York Department of Agriculture and Markets
REV	Reforming the Energy Vision
HVSEC	Hudson Valley Smart Energy Coalition
OCCA	Otsego County Conservation Association
VOM	Variable Operations and Maintenance

EXECUTIVE SUMMARY

In this Final Report, Staff of the Department of Public Service (Trial Staff) completes a comparative evaluation of twenty-two transmission proposals and several non-transmission alternatives and concludes that the Public Service Commission should proceed to significantly enhance New York State's bulk electric system by endorsing a specific portfolio of electric transmission upgrade projects. The infrastructure investments proposed by Trial Staff have an estimated construction cost of approximately $1.2 billion and will increase the bulk power transfer capability between Upstate and Downstate New York by approximately 1,000 megawatts, meeting the original goals for these proceedings. The developers that competed in the comparative evaluation offered many different ideas as to how best to upgrade the electric grid. Similarly, the public interest parties that participated ensured that environmental impacts and system alternatives would be given due consideration. All of the information provided contributed greatly to Trial Staff being able to devise a portfolio that meets a variety of needs and strikes a beneficial balance between the many competing interests including, among others: transfer capability; cost; electric system impacts, emissions reductions, and production cost impacts; need to acquire additional rights-of-way; the application of innovative technologies; environmental compatibility; and visual impacts. In particular, many of the proposals and critiques were responsive to the Governor's call for transmission solutions that maximize the re-use of existing rights-of-way so as to minimize impacts on the sensitive landscapes of New York such as in the Mohawk and Hudson Valleys. In that regard, Trial Staff's recommended portfolio successfully avoids the opening of new transmission rights-of-way and also avoids a new crossing of the scenic Hudson River by a new power line.

Trial Staff concludes that the Commission should find and determine that there is a need for the identified portfolio of projects driven by Public Policy Requirements, including the need to: reduce transmission congestion so that large amounts of power can be transmitted to regions of New York where it is most needed; reduce production costs through congestion relief; reduce capacity resource costs; improve market competition and liquidity; enhance system reliability, flexibility, and efficiency; improve preparedness for and mitigation of impacts of generator retirements; enhance resiliency/storm hardening; avoid refurbishment costs of aging transmission; take better advantage of existing fuel diversity; increase diversity in supply, including additional renewable resources; promote job growth and the development of new efficient generation resources Upstate; reduce environmental and health impacts through reductions in less efficient electric generation; reduce costs of meeting renewable resource standards; increase tax receipts from increased infrastructure investment; enhance planning and operational flexibility; obtain synergies with other future transmission projects; and relieve gas transportation constraints. Such a finding will trigger a solicitation and review of transmission solutions by the New York Independent System Operator (NYISO) with the potential for selected transmission developers to obtain cost recovery for their development and construction costs from the beneficiaries of the transmission upgrades through a NYISO tariff mechanism regulated by the Federal Energy Regulatory Commission (FERC).

Background

The Public Service Commission initiated the AC Transmission proceedings to consider whether to address the persistent transmission congestion that exists at the Central East and Upstate New York/Southeast New York (UPNY/SENY) electrical interfaces. The Commission sought proposals from transmission owners and other developers proposing projects to increase the UPNY/SENY transfer capacity by approximately 1,000 MW. After an initial round of proposals were received that raised environmental siting concerns, the Commission called for revised proposals that would better utilize existing rights-of-way and better match the scale of proposed power line structures to be in keeping with existing facilities already in the landscape. The Commission's directive was consistent with Governor Cuomo's declaration in the 2014 State of the State Address that the State must encourage utilities and transmission developers to build wholly within existing transmission corridors, where possible, in order to minimize impacts and responsibly site projects in a way that is responsive to the concerns of local communities.

Twenty two proposals were received from four entities: North America Transmission LLC and North America Transmission Corporation (NAT), the New York Transmission Owners (NYTOs),[1] NextEra Energy Transmission New York, Inc. (NextEra), and Boundless Energy NE, LLC (Boundless) (collectively, the Applicants). Thereafter, the Commission directed Trial Staff, with the assistance of the NYISO, to undertake a comparative

[1] The NYTOs include Central Hudson Gas & Electric Corporation, Consolidated Edison Company of New York, Inc., New York Power Authority, New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation, Orange and Rockland Utilities, Inc., and Rochester Gas and Electric Corporation respectively.

evaluation of the project proposals. The comparative evaluation study required significant computer modeling of power flows, electric generation production cost benefits, and electric generation capacity cost benefits and resulted in a benefit cost analysis for each project. In addition, each project was analyzed as to its specific environmental impacts. The study also included an analysis of alternatives to a transmission facility to address the issue of whether there is sufficient public need for a transmission solution as a matter of public policy.

An initial result of that analysis was the Trial Staff Interim Report dated July 6, 2015, which addressed primarily the issues of environmental compatibility and beneficial electric system impacts on the Central East and Upstate New York/Southeast New York (UPNY/SENY) electrical interfaces. On June 12, 2015, it was announced in the press that the planned 720 MW CPV Valley generation facility has obtained its financing and will be proceeding to construction. This significant change in the New York bulk electric system required Trial Staff to update its power flow, production cost benefit, and capacity cost benefit studies to reflect the change. Therefore, the remaining projects were further studied considering the effects of the 720 MW CPV Valley facility.

After the issuance of the interim Trial Staff report, the parties to the AC Transmission proceedings met in a Technical Conference to review the findings and exchange further information. The comments received at that Technical Conference are reflected in this Report. Most notably, Staff received comments from NextEra regarding the inclusion of an Oakdale-Fraser segment in each of its projects. For purposes of the final report, Staff has removed this segment from NextEra’s other projects and evaluated it as a standalone project, Project 19b.

This Final Report has been updated to address the new information, and a second Technical Conference will be held in October. Staff's recommendation will also be put out for public comment, including notice in the State Register, and the Commission will receive and review the comments before taking any action. Below are sections that summarily describe Trial Staff's process as it analyzed the proposals leading to the final recommendations in this Final Report.

Environmental Compatibility

Using data provided by the Applicants and supplemented by Trial Staff, a number of environmental factors were either quantitatively or qualitatively considered for each project. The data used is also presented in a matrix to illustrate the impacts on a comparative basis.

Trial Staff evaluated the environmental factors for each of the project scenarios in a multiple step process that combined the quantified, or measured, characteristics of each scenario with the qualitative environmental impact assessment performed by Staff. Each of the quantified characteristics, such as number of streams or federal (National Wetlands Inventory) wetlands located in a ROW, miles of right-of-way (ROW), area of forests, forested wetlands, numbers of structures within 250 feet of residences, or State or National Register of Historic Places sites within one mile of the ROW were assigned rankings of Low, Medium, and High. The parameter rankings were established by calculating the average (mean) for each measurable factor. The Medium rank ranges represent one-half of a standard deviation on either side of the calculated mean. Low rankings were assigned to values less than the medium rank range and high rankings were assigned to values greater than the medium rank range. Qualitative ratings of visual, sound and river corridor impacts were prepared to have a consistent approach to these parameters.

Following the completion of the quantitative environmental parameters ratings, Trial Staff completed an overall rating for each scenario. The overall rating is not a numerical score but a qualitative assessment of the anticipated outcome of transmission facility construction in a selected ROW. The rankings are intended for comparative evaluation only. Projects with an overall ranking of "Low" are anticipated to be most environmentally compatible of the proposed projects, whereas project scenarios with an overall environmental ranking of "High" are anticipated to be the least environmentally compatible. "Low" ranking may still represent significant impacts that will warrant mitigation to ultimately support a finding that the impacts have been minimized to the maximum extent practicable.

Projects rated in the "High" category, in comparison to the remaining scenarios, have the potential for greater environmental impacts, primarily as a result of the need for new or expanded rights-of-way, or the planned use of Thruway right-of-way which is fraught with complications. The remaining scenarios are significantly more environmentally compatible primarily because they are designed to use existing rights-of-way.

Staff's environmental review results in the following comparative ratings:

ES Figure 1: Environmental Rankings

Project Environmental Rankings		
Portfolio	**Impact on Environment**	
P1 - NAT	HIGH	
P2 - NAT	HIGH	
P3 - NAT	HIGH	
P4 - NAT	HIGH	
P5 - NAT	HIGH	
P6 - NYTO	LOW	
P7 - NYTO	LOW	
P8 - NYTO	LOW	
P9 - NYTO	LOW	
P10 - NYTO	HIGH	
P11 - NYTO	MEDIUM	
P12 - NYTO	MEDIUM	
P13 - NYTO	MEDIUM	
P14 - NYTO	MEDIUM	
P15 - NextEra	HIGH	
P16 - NextEra	MEDIUM	
P17 - NextEra	HIGH	
P18 - NextEra	HIGH	
P19a - NextEra	LOW	
P19b - NextEra	MEDIUM	
P20 - Boundless	MEDIUM	
P21 - Boundless	LOW	

Electric System Impacts

The New York Independent System Operator (NYISO), with the assistance of the Power Systems Studies Group of its consultant, TRC Environmental Corporation (TRC), assessed each project scenario for reliability and system impact implications. These assessments model power flows on the bulk electric system to identify the degree to which transmission capability changes at various locations on the electric system as a result of a given transmission upgrade. For the analysis described here, the key transmission points studied are the Central East and UPNY-SENY transmission interfaces. The table below summarizes the results of the power flow assessments. The numbers above represented the initial power flow before the addition of the CPV project gained financial approval. NYISO then ran power flow analysis that included CPV. Below is the new power flow analysis including CPV. Several projects such as 6, 19a, 11, and 14 proved to have the most significant impacts on the UPNY/SENY and Central East after CPV Valley was added to the base case.

ES Figure 2: UPNY/SENY Limit Increases With & Without CPV Valley in Base Case

PROJECT SCENARIOS	Normal & Emergency Transfer Capability Impact (MW)					
	UPNY/SENY NTC Limit Increase w/o CPV	UPNY/SENY NTC Limit Increase w/ CPV	Delta	UPNY/SENY ETC Limit Increase w/o CPV	UPNY/SENY ETC Limit Increase w/ CPV	Delta
P1 - NAT	1,729	2,106	377	2,722	2,385	(337)
P2 - NAT	1,179	1,710	(69)	2,122	2,271	149
P3 - NAT	1,717	2,138	421	2,657	1,709	(948)
P4 - NAT	933	1,463	530	1,203	2,227	1,024
P5 - NAT	959	1,524	565	1,880	2,101	221
P6 - NYTOs	656	918	262	1,544	1,686	142
P7 - NYTOs	1,243	352	(891)	1,243	1,404	161
P8 - NYTOs	(469)	(330)	139	116	236	120
P9 - NYTOs	1,351	1,038	(313)	1,598	2,091	493
P10 - NYTOs	638	1,206	568	1,507	1,907	400
P11 - NYTOs	603	939	336	1,469	1,621	152
P12 - NYTOs	1,200	432	(768)	1,200	1,341	141
P13 - NYTOs	(677)	(329)	348	(108)	215	323
P14 - NYTOs	1,500	1,136	(364)	2,460	2,286	(174)
P15 - NextEra	874	1,476	602	1,780	2,203	423
P16 - NextEra	697	1,270	573	1,587	1,994	407
P17 - NextEra	817	1,328	511	1,653	2,072	419
P18 - NextEra	558	1,149	591	1,436	1,858	422
P19a - NextEra	697	961	264	1,528	1,747	219
P19b - NextEra	N/A	N/A	N/A	N/A	N/A	N/A
P20 - Boundless	588	687*	99	588	1,753	1,165
P21 - Boundless	482	605*	123	482	1,433	951

* For P20 and P21, the stuck breaker contingency is ignored
+Base Case w/o includes Athens SPS, change cases do not.

Construction Costs

Trial Staff reviewed the construction cost information provided by the applicants and created its own estimates of construction costs. The parties discussed the differences in their estimates in the Technical Conference process. In general, Trial Staff made additions to cost estimates that did not fully consider the costs associated with matting and access road construction, as well as substation and other interconnection facilities. Common additions, including work on the Chester-Shoemaker-Sugarloaf line and Rock Tavern Terminal upgrades were also added to all scenarios except 20 and 21. Trial Staff also normalized all cost estimates to 2015 dollars.

The result of Trial Staff's review of construction costs is shown in the table below:

ES Figure 3: Applicant vs. DPS Construction Cost Estimates

Construction Cost Estimates		
Project	**Applicant Cost**	**DPS Cost**
P1 - NAT	$668,750,000	$857,545,283
P2 - NAT	$864,750,000	$1,020,716,732
P3 - NAT	$710,208,000	$911,440,683
P4 - NAT	$1,077,291,000	$1,281,224,240
P5 - NAT	$1,033,459,000	$1,224,242,640
P6 - NYTO	$616,973,842	$631,056,714
P7 - NYTO	$359,331,390	$361,121,527
P8 - NYTO	$242,082,849	$226,353,075
P9 - NYTO	$635,172,770	$630,947,291
P10 - NYTO	$1,404,610,880	$1,439,170,175
P11 - NYTO	$1,194,071,098	$1,188,796,308
P12 - NYTO	$1,104,641,757	$1,090,171,234
P13 - NYTO	$848,286,806	$822,562,139
P14 - NYTO	$1,238,635,727	$1,218,317,655
P15 - NextEra	$735,117,633	$864,836,574
P16 - NextEra	$701,699,107	$856,691,318
P17 - NextEra	$842,722,379	$1,038,632,316
P18 - NextEra	$657,237,913	$823,448,288
P19a - NextEra	$386,137,312	$460,855,417
P19b - NextEra	$263,160,114	$331,366,235
P20 - Boundless	$736,715,587	$917,905,890
P21 - Boundless	$509,526,682	$671,472,003

Public Policy Need For Transmission

In the Order instituting Case 12-T-0502, the Commission explained that the transmission corridors that include the Central East and UPNY/SENY electrical interfaces were persistently congested and that this congestion contributes to higher energy costs, especially in the SENY region, as well as reliability concerns. The Commission recognized that upgrades to those sections of the electric transmission system could produce various benefits for New York, including: 1) enhancing system reliability, flexibility, and efficiency; 2) reducing environmental and health impacts through reductions in less efficient electric generation; 3) increasing diversity in supply, including additional renewable resources; 4) promoting job growth and the development of new efficient generation resources Upstate; and, 5) mitigating reliability problems that may arise with expected generator retirements.

As discussed more thoroughly in the body of the Final Report, Staff believes that its proposal secures the benefits sought by the Commission. The Staff Final Report indicates a single corridor rather than a specific project should be adopted for Public Policy reasons and that competition should used to provide the Public Policy need at the lowest costs to ratepayers.

Comparative Evaluation Results and Recommendations

In conducting its final analysis, Staff followed a similar methodology to that used in the Interim Report. The following screens were used to winnow out projects and ultimately reach our recommendation. First, those with a High environmental ranking were eliminated as projects with the same or better Power Flow results and lower environmental impacts remained. This eliminated Projects 1-5 (all of NAT's portfolios), 10, 15, 17, and 18. Second, projects with a negative or marginal impact on UPNY/SENY were eliminated. This removed Projects 8, 13, and 19b from consideration. Third, any projects with a Cost/Benefit Ratio below 1.0 were eliminated as not being able to meet the public policy needs outlined above. This removed both of Boundless' projects, 20 and 21 from consideration. Staff then winnowed out projects with a Medium environmental rating and a Power Flow impact of less than 900 MW on UPNY/SENY or a negative impact on Central East. This removed Projects 7 and 12 from further consideration.

These screens reduced the number of projects being considered for recommendation by Staff to Projects 6/19a, 9, 11, 14, and 16 remaining. The table below details the costs and benefits associated with these remaining proposals.

ES Figure 4: Comparison of Remaining Proposed Projects

Millions 2015 $	P19a NextEra	P6 NYTO	P9 NYTO	P16 NextEra	P11 NYTO	P14 NYTO
MONETIZED COSTS (PVRR)	**$648**	**$887**	**$887**	**$1,166**	**$1,671**	**$1,713**
Monetized Benefits						
Production Cost Savings	$221	$221	$262	$221	$516	$547
Capacity Resource Savings	$285	$284	$286	$285	$286	$286
RPS/CO2 Goals	$27	$27	$41	$27	$97	$108
Avoided Transmission Cost	$264	$281	$260	$998	$998	$995
Total Tax Benefit	$87	$142	$151	$40	$151	$169
TOTAL MONETIZED BENEFIT	**$884**	**$955**	**$1,000**	**$1,571**	**$2,048**	**$2,105**
BENEFIT COST RATIO	**1.36**	**1.08**	**1.13**	**1.35**	**1.23**	**1.23**
NET PRESENT VALUE (Monetized PVRR)	$236	$68	$113	$405	$377	$392
UPNY-SENY NTC MW	961	918	1,038	961	939	1,136
CENTRAL EAST NTC MW	50	50	50	50	375	375
UPNY-SENY ETC MW	1,747	1,686	2,091	-	1,621	2,286
ENVIRONMENTAL IMPACTS RANK	Low	Low	Low	Medium	Medium	Medium
HUDSON RIVER CROSSING	None	None	Full-Leeds	None	None	Full-Leeds

Notes: Notes: NTC=Normal Transfer Capability; ETC=Emergency Transfer Capability; PVRR=Present Value Revenue Requirement)

Staff did however examine one additional option, as requested by the Applicants during the Technical Conferences. Staff, in conjunction with the NYSIO, evaluated the possibility of building the Roseton-Fishkill segment proposed by Boundless together with either Project 9 or 14. The theory behind this examination was that the ability of Boundless' proposed Roseton-Fishkill line to carry additional capacity from CPV Valley could increase the ability of Project 9 or 14 to move power across UPNY/SENY and therefore result in higher net benefits for a relatively small additional cost. Examination of this theory however, proved it to not be the case. While combining these projects did produce additional transfer capability across UPNY/SENY, these gains were marginal compared to the increased cost, meaning any combination project saw a reduction in overall benefit. A full examination of these combinations is contained in the figure below.

ES Figure 5: Examination of Value of Combination Projects

Millions 2015 $	Combo 1 P14&P21a	Combo 3 P9&P21a	Combo5 P11&P21a	Combo 1 Val Add P14&P21a	Combo 3 Val Add P9&P21a	Combo5 Val Add P11&P21a
MONETIZED COSTS (PVRR)	**$2,194**	**$1,368**	**$2,152**	**$481**	**$481**	**$481**
Monetized Benefits (PVRR)						
Production Cost Savings	$547	$262	$516	$0	$0	$0
Capacity Resource Savings	$286	$286	$286	$0	$0	$0
RPS/CO2 Goals	$108	$41	$97	$0	$0	$0
Avoided Transmission Cost	$995	$260	$998	$0	$0	$0
Total Tax Benefit	$288	$266	$277	$119	$115	$126
TOTAL MONETIZED BENEFIT	**$2,224**	**$1,115**	**$2,174**	**$119**	**$115**	**$126**
BENEFIT/COST RATIO	**1.01**	**0.82**	**1.01**	**0.25**	**0.24**	**0.26**
NET PRESENT VALUE (Monetized PVRR)	$30	($253)	$22	($362)	($366)	($355)
UPNY-SENY NTC MW	1,654	1,480	1,313	518	442	374
CENTRAL EAST NTC MW	375	50	375	0	0	0
UPNY-SENY ETC MW	2,204	2,013	1,826	(82)	(78)	205
ENVIRONMENTAL IMPACTS RANK	Med/Low	Low	Med/Low			
HUDSON RIVER CROSSING	Full-Leeds	Full-Leeds	None			

Notes: NTC=Normal Transfer Capability; ETC=Emergency Transfer Capability; PVRR=Present Value Revenue Requirement)

In reviewing all factors, the work proposed by the NYTOs in Project 11 best meets all public policy objectives.

First, from an environmental perspective, Project 11 does not result in any crossing of the Hudson River, whether via a new circuit or a reconductoring or replacement of an existing circuit. This avoids impacts to sensitive environmental and scenic resources and is a major benefit of Project 11 over Project 14. Project 11, like all other projects remaining for consideration, would be built entirely within existing ROW, further reducing environmental impacts.

From a Power Flow standpoint, Project 11 results in a 961-MW increase of the UPNY/SENY NTC with CPV Valley in service. This is very close to the Commission's original goal of moving an additional 1000 MW over the UPNY/SENY interface. Projects 6 and 19a are capable of moving a similar amount of power across this interface; however, Project 11 also results in a 375-MW increase in Central East NTC, whereas other projects only increased the Central East NTC by 25-50 MW. Trial Staff recommends Project 11 over Project 16 based on this type of comparison. Project 11 includes an Edic-New Scotland segment, while Project 16 includes a Marcy-Princetown segment that does not involve the building of a new circuit to New Scotland. With respect to UPNY/SENY, these projects are nearly identical. Project 11 and 16 have different impacts on Central East voltage limits, however. Project 11 increases the Central East thermal limit by 412 MW, Project 16 only results in an increase of 56 MW. This is because the transmission segments between Princetown and New Scotland in Project 16 become limiting, as there is not enough transmission to carry the increased power all the way to New Scotland. This means that the Marcy-Princetown segment proposed in Project 16 would be underutilized, resulting in less production cost savings and ultimately less benefit from the line. Project 16 therefore is recommended for elimination by Trial Staff. This leads to higher production cost savings in the Brattle MAPS modeling and ultimately more benefits for New York.

Project 11 also results in other Public Policy Benefits including the potential for interconnection of new generation sited upstate (including renewable generation), increased employment in the form of construction and other jobs, a reduction of $97 million in the cost associated with meeting RPS/CO2 goals, $998 million in avoided future transmission refurbishment costs on Edic-New Scotland line $286 million in capacity resource savings, $516 million in production cost savings, $151 million in increased tax revenue and finally an increased ETC rating of 1,621 MW on UPNY/SENY.

In conducting Power Flow Analyses with CPV Valley included, the NYISO determined that all projects, with the exception of those proposed by Boundless, trigger a contingency on the Orange and Rockland Chester-Shoemaker line, which must be bypassed for any of the projects to produce a positive benefit. In other words, if the Sugarloaf to Chester line is not upgraded, the transmission project recommended by Trial Staff would not be able to operate at full capacity as the Sugarloaf to Chester line is limiting.

Competition

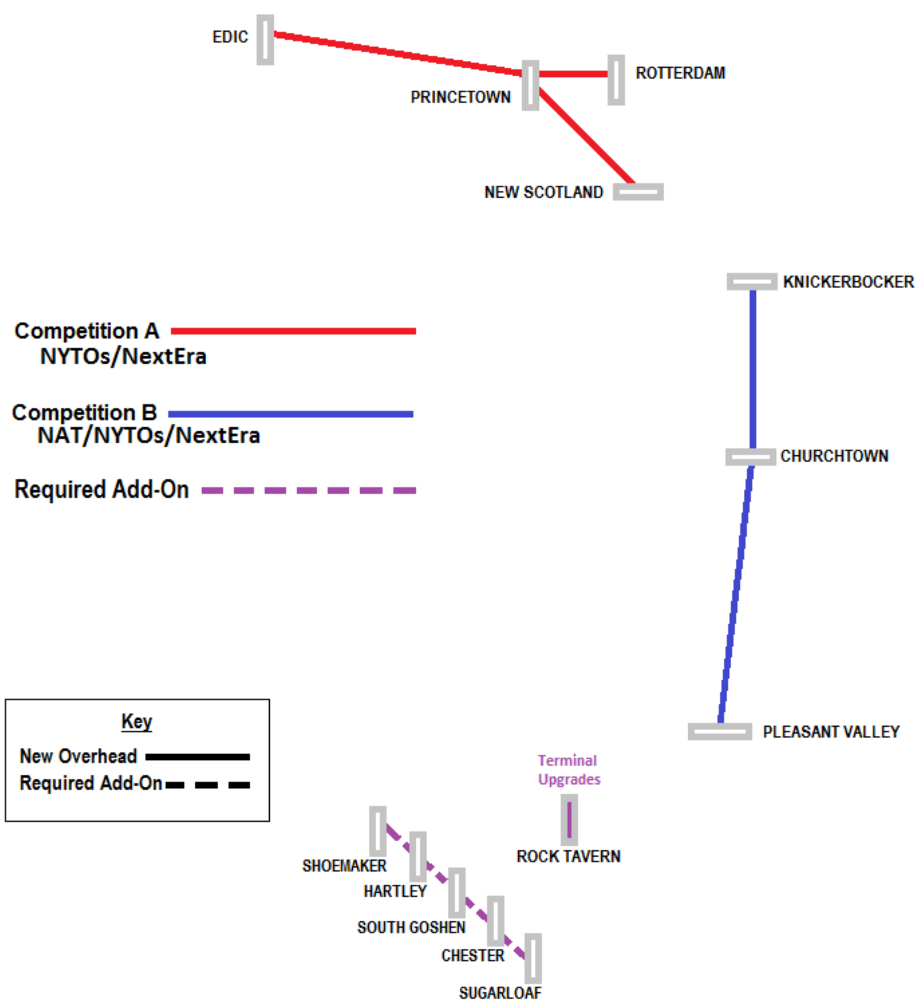
Other applicants proposed the same or similar work in the same transmission corridors as Project 11. In examining the various cost estimates filed by the Applicants, DPS Staff has determined that the net benefits presented by Project 11 could conceivably be higher if other developers were given an opportunity to bid the project rather than solely selecting the NYTOs. Therefore, in order to promote competition and encourage the lowest cost project to be built in the interest of ratepayers, project should be divided into two segments, each open to competition ED-NS/R (NYTOs and NextEra), KB-PV (NAT, NextEra, and NYTOs). These respective developers proposed the same or similar work in these corridors.

NAT's Application included an indication that it could develop the Knickerbocker – Pleasant Valley segment exclusive of the New-Scotland – Knickerbocker – Churchtown - Pleasant Valley

Alternate 2 scenario as described above in Scenario 5. NAT proposed the construction of a 345 kV overhead transmission line from Knickerbocker to Pleasant Valley in an existing 115 kV ROW. The NAT Scenario 5 (Alternative 2) uses a 115 kV ROW that is west of the proposed ROW used by NYTO and NextEra. This segment would be assigned a comparative environmental ranking of Low.

The NYTOs proposed both segments in Project 11, NextEra proposed GB-PV in Project 19a and ED-NS in Projects 17-18. These developers for these segments should be invited by the Commission to file with the NYISO and receive development costs under the NYISO's tariff. A graphic representation of Staff's recommendation is below.

ES Figure 6: Trial Staff's Recommended Transmission Solution



Further, any Applicant seeking to build the Knickerbocker-Pleasant Valley project must also work with Orange and Rockland Utilities, Inc. to ensure that the Rock Tavern Substation terminal upgrades are made and the Shoemaker-Sugarloaf line is upgraded.

Conclusion

Trial Staff recommends that the Commission find and determine that there is a need for the identified portfolio of projects driven by Public Policy Requirements. Such a finding will trigger a solicitation and review of transmission solutions by the NYISO with the potential for selected transmission developers to obtain cost recovery for their development and construction costs from the beneficiaries of the transmission upgrades through a NYISO tariff. The NYTOs and NextEra should be invited to propose their solutions to build both segments and NAT should be invited to propose its solution to build the Greenbush/Knickerbocker - Pleasant Valley segment. This portfolio of projects is most promising from an electric system benefit perspective, and is significantly more environmentally compatible primarily because it is designed to use existing rights-of-way, and generally replace existing facilities with new facilities while largely avoiding significant new intrusions into existing communities, landscapes and farmland. As stated above, any Applicant seeking to build the Knickerbocker-Pleasant Valley project should be required to also work with Orange and Rockland Utilities, Inc. to ensure that the Rock Tavern Substation and Chester-Shoemaker-Sugarloaf power line upgrades are made. Trial Staff's final recommendation for each proposed project is included in the table below.

ES Figure 7: Final Recommendations Regarding Proposed Projects

Portfolio	Impact on Environment	UPNY-SENY NTC Limit Increase (MW)	Benefit/Cost Ratio	Disposition
P1 - NAT	HIGH	2,106		Eliminated (2)
P2 - NAT	HIGH	1,710		Eliminated (2)
P3 - NAT	HIGH	2,138		Eliminated (2)
P4 - NAT	HIGH	1,463		Eliminated (2)
P5 - NAT	HIGH	1,524		Eliminated (2) in Part Retained in Part (KB-PV)
P6 - NYTO	LOW	918	1.1	Retained in Full
P7 - NYTO	LOW	352	1.3	Eliminated (4)
P8 - NYTO	LOW	(330)		Eliminated (1)
P9 - NYTO	LOW	1,038	1.1	Eliminated (5)
P10 - NYTO	HIGH	1,206		Eliminated (2)
P11 - NYTO	MEDIUM	939	1.2	Retained in Full
P12 - NYTO	MEDIUM	432	1.3	Eliminated (4)
P13 - NYTO	MEDIUM	(329)		Eliminated (1)
P14 - NYTO	MEDIUM	1,136	1.2	Eliminated (5)
P15 - NextEra	HIGH	TBD		Eliminated (2)
P16 - NextEra	MEDIUM	TBD		Eliminated (6)
P17 - NextEra	HIGH	TBD		Eliminated (2) in Part, Retained in Part (M-NS)
P18 - NextEra	HIGH	TBD		Eliminated (2)
P19a - NextEra	LOW	961	1.4	Retained in Full
P19b - NextEra	MEDIUM	N/A		Eliminated (1)
P20 -Boundless	MEDIUM	687*	0.7	Eliminated (3)
P21 -Boundless	LOW	605*	0.7	Eliminated (3)

Notes
1: Eliminated due to Negative UPNY/SENY Impact
2: Eliminated due to High Environmental Ranking
3: Eliminated due to Benefit/Cost Ratio below 1.0
4: Eliminated due to Medium or Low Environmental Ranking & Power Flow Below 900 MW on UPNY/SENY
5:Eliminated as result of on-balance final analysis
6:Eliminated based on Central East (production cost) impacts compared with P11 and 14.

INTRODUCTION

The New York State Public Service Commission initiated Case 12-T-0502, et al. in order to consider whether and how to address the persistent transmission congestion that exists at the Central East and Upstate New York/Southeast New York (UPNY/SENY) electrical interfaces. In the Order instituting Case 12-T-0502, the Commission explained that the transmission corridors that include the Central East and UPNY/SENY electrical interfaces were persistently congested and that this congestion contributes to higher energy costs, especially in the SENY region, as well as reliability concerns. The Commission recognized that upgrades to those sections of the electric transmission system could produce various benefits for New York, including: 1) enhancing system reliability, flexibility, and efficiency; 2) reducing environmental and health impacts through reductions in less efficient electric generation; 3) increasing diversity in supply, including additional renewable resources; 4) promoting job growth and the development of new efficient generation resources Upstate; and, 5) mitigating reliability problems that may arise with expected generator retirements.[2] As part of its ongoing review in these cases, the Commission directed that each of the Applicants propose projects to address these issues, which would be evaluated on a competitive, comparative basis. On January 7, 2015, in response to this directive, four Applicants, North America Transmission Corporation (NAT), the New York Transmission Owners (NYTOs),[3]

[2] Case 12-T-0502, Order Instituting Proceeding (issued November 30, 2012), pp. 1-2.

[3] The NYTOs include Central Hudson Gas & Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation, and Orange and Rockland Utilities, Inc. respectively.

NextEra Energy Transmission New York, Inc. (NextEra), and Boundless Energy NE, LLC (Boundless) (collectively the Applicants), filed Part A Applications (collectively the Applications) with the Commission. Trial Staff previously filed an Interim Report in this case that recommended the elimination from consideration of the majority of the projects. The following Final Report both includes and builds upon the analysis contained in the Interim Report and represents a final analysis of these Applications conducted by Department of Public Service Trial Staff (Trial Staff) in concert with the New York Independent System Operator (NYISO) and consultants retained by NYISO, including The Brattle Group, Inc. (Brattle) and TRC Environmental Corporation (TRC). This Final Report and the accompanying motion also recommends that the Commission declare for the reasons detailed in this Final Report that a public policy need exists in the Mohawk and Hudson Valley corridors and that the NYISO issue an RFP seeking proposals to build two segments, Edic-New Scotland-Rotterdam, and Knickerbocker/Greenbush-Pleasant Valley. Each segment will be open to competition and for the reasons stated below, the NYTOs and NextEra should be invited to file proposals with the NYISO for both segments. NAT should be invited to submit a proposal for the Knickerbocker/Greenbush-Pleasant Valley segment.

BACKGROUND

New York State's electric transmission system faces a longstanding problem of congestion at critical points on the pathways linking Upstate and Downstate New York. Together, New York City, Long Island, and Westchester County account for more than half of the total demand for electricity in the State and peak demand in that area continues to increase; however, in times of peak demand and high prices, lower-cost and/or cleaner power available from Upstate cannot reach these densely populated areas because of transmission system congestion or "bottlenecks." Congestion can have adverse environmental and economic consequences when older, less efficient and more expensive fossil fuel plants in urban areas run more frequently than they otherwise would if power from other cleaner cheaper sources of energy could reach these areas.[4] The Alternating Current (AC) electric transmission system is the backbone of a reliable transmission system. The AC system promotes reliability through its ability and flexibility to respond to emergencies on the system. Unlike Direct Current (DC) transmission lines, the AC system also allows for the interconnection of needed generation resources at multiple points on the system. DC lines serve the purpose of moving energy over long distances and interconnecting incompatible systems.

Prudent transmission planning evaluates all alternatives, including AC and DC transmission, generation, energy efficiency and other demand-side options — so as to identify new infrastructure to provide the most robust system at

[4] Staff notes that the recently released State Energy Plan 2015, *The Energy to Lead*, calls for the allocation of nearly $19 million for urban areas to shut down carbon-intensive power plants in favor of cleaner fuel sources in recognition of this problem.

a reasonable cost to ratepayers. While congestion can also be reduced through strategically placed generation or DC transmission investments, AC investments provide the additional benefit of contributing to a system that is more robust and flexible with increased reliability benefits, thereby increasing the area within which generation facilities can be placed to respond to future system needs. Prudent projects have the benefit of reducing in-state transmission constraints, supporting the development of Upstate renewable energy projects, and lowering wholesale energy prices for Downstate energy consumers, while not disproportionally raising rates for Upstate consumers as a result. Further, upgrades to the AC system should provide economic development benefits to Upstate by enabling excess energy from Upstate power plants to reach Downstate markets, improving the financial viability of existing Upstate power producers, and allowing existing and future wind farms and other renewable sources in that region to access higher-priced energy markets.

In assessing the need in this State for increased transmission, the Commission was informed by several studies conducted at both the State and Federal levels. In 2005 the Energy Policy Act was passed requiring the U.S. Department of Energy (DOE) to evaluate congestion constraints nation-wide. As a result of this evaluation the DOE found that New York had significant constraints. Part of the Energy Policy Act would allow for FERC to supersede local planning efforts if they found deficiencies in the transmission system. These deficient areas are referred to as National Interest Corridors (NIETC). In 2006 the first DOE report found that:

> New York City’s electricity supply problems are especially complex and difficult. Building new generation capacity within the city is extremely challenging because of air quality restrictions, high

> real estate values, fuel supply problems, and local opposition to power plants. Some additional generation is being added north of the city to serve the city's requirements. Adding major new transmission lines to the north and northwest would increase the options available to the city for power. During the summer the city could be served by excess, relatively inexpensive hydropower from Canada. The flexibility provided by new transmission could also enable the city to tap recently proposed in-state wind power and clean coal generating capacity, if they are developed.[5]

DOE's 2009 National Electric Transmission Study reaffirmed its findings in 2006, stating that "little new transmission has been built in the region in the past three years, although many new backbone and expansion projects are nearing construction; therefore it is likely to be several years before current congestion levels ease."[6] The draft DOE National Electric Transmission Study in August 2014 again highlighted New York's constrained area.[7]

The Joint Coordinated System Plan (JCSP) 2008 Report issued February 2009 was the first effort at an interconnection-wide study. While the purpose of the study was to determine possible interconnection-wide upgrades to distribute renewable energy, the report identified constraints in eastern New York as some of the most severe in the country.

The next look at the eastern interconnection took place in a DOE funded study by the Eastern Interconnection Planning Collaborative (EIPC). This study took three different views of the future to determine what transmission upgrades might be required by 2030; Business As Usual, Nationally-

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[5] National Electric Transmission Study 2006, p. 57.

[6] National Electric Transmission Congestion Study December 2009, p. x.

[7] Draft for Public Comment National Electric Transmission Congestion Study August 2014, p. xxii.

Implemented Federal Carbon Constraint with Increased Energy Efficiency/Demand Response, and Regionally Implemented Renewable Portfolio Standard. Transmission constraints in the Mohawk-Hudson Valley were identified in all three scenarios.[8]

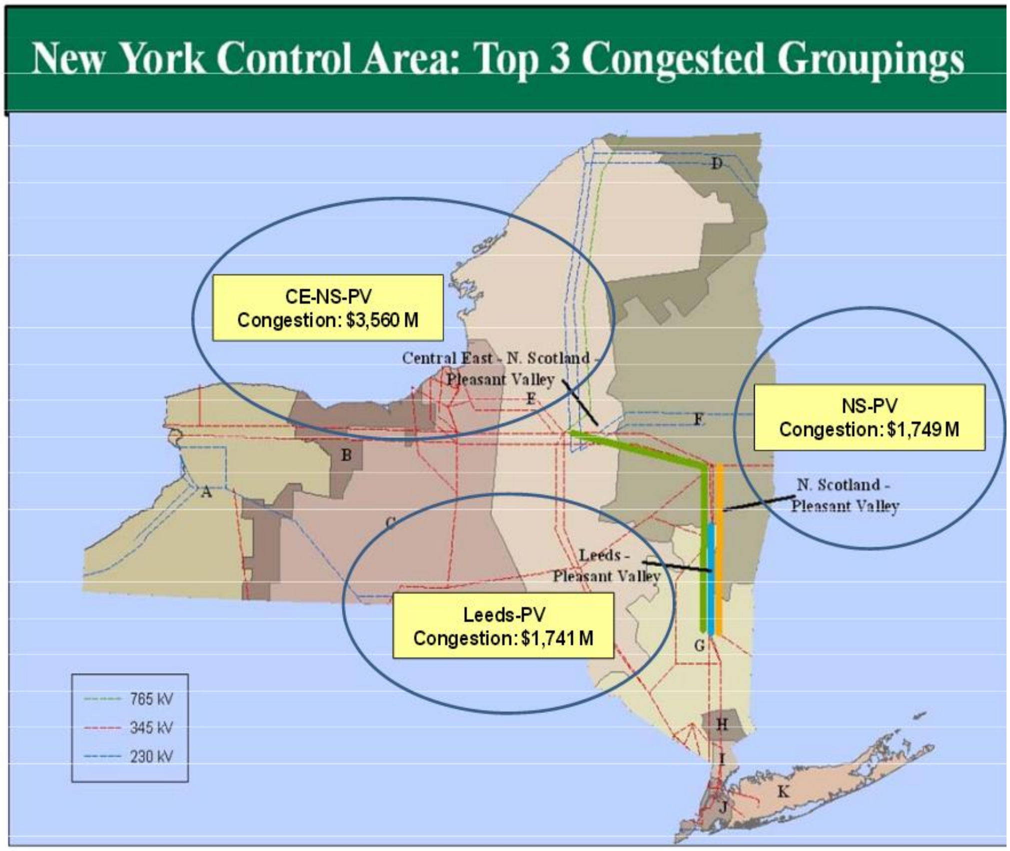
At the State level, the NYISO's Congestion Assessment and Resource Integration Study (CARIS) perform an economic analysis of the transmission system every two years. The study protocol is to examine the three most congested areas of the New York transmission system every two years. In the 2009 study the Central-East Interface and the Leeds-Pleasant Valley Corridor were identified as two of the three most congested corridors.[9] The 2011 study identified the three top transmission constrained areas in the State and found them to be the Central East-New Scotland-Pleasant Valley, New Scotland-Pleasant Valley, and Leeds-Pleasant Valley sections.[10]

8 Phase 2 Report: DOE Draft - Part 1 Interregional Transmission Development and Analysis for Three Stakeholder Selected Scenarios December 22, 2012, pp. 14-15

9 2009 Congestion Assessment and Resource Integration Study: CARIS-Phase I, January 12, 2010

10 2011 Congestion Assessment and Resource Integration Study: CARIS-Phase I, March 20, 2012

Figure 1: Congestion on the Top Three CARIS Studies (Present Value in 2011 $M)

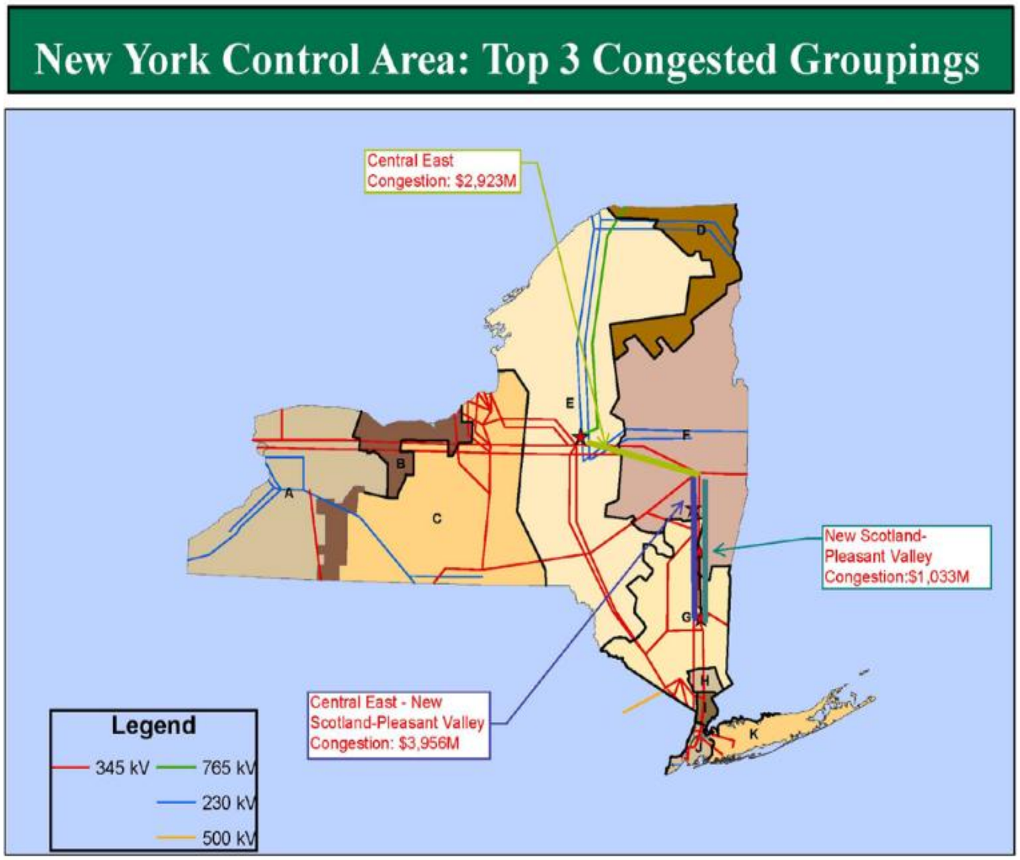


Source: NYISO, 2011 Congestion Assessment and Resource Integration Study: CARIS-Phase I, March 20, 2012, p. 7

In the 2013 study, the three top transmission constraint groupings were identified to be Central-East, New Scotland-Pleasant Valley, and Central East-New Scotland-Pleasant Valley.[11] For eight of the nine study areas examined in all the NYISO CARIS studies, the Mohawk Valley through Lower Hudson Valley transmission corridor, as indicated by the graphics below, was identified as the most constrained areas in the New York transmission system.

[11] 2013 Congestion Assessment and Resource Integration Study: CARIS-Phase I, November 19, 2013

Figure 2: Congestion on the Top Three CARIS Studies (Present Value in 2013 $M)



Source: NYISO, 2013 Congestion Assessment and Resource Integration Study: CARIS-Phase I, November 19, 2013, Fig 5-3, p. 37

The NYTOs, as well as the Long Island Power Authority, the New York Power Authority, and Rochester Gas and Electric, with the cooperation of the NYISO and ABB performed the State Transmission Assessment and Reliability Study (STARS). Phase I of the study evaluated the condition of transmission assets to determine what aging infrastructure would need attention in the near future. Phase II looked at what upgrades to the system would be required to address aging infrastructure in the future. Phase II also identified potential wind energy development interconnection opportunities and future reliability needs of the New York system. This study again identified a need to reinforce the total East/Central East and UPNY-SENY interfaces by rebuilding existing and/or constructing new facilities from Marcy to Leeds to Pleasant Valley.[12]

The multiple studies outlined above established the existence of persistent congestion in the Mohawk and Hudson Valley transmission corridors and concluded that this congestion is expected to persist well into the future without corrective action.

[12] New York State Transmission Assessment and Reliability Study – Phase II Study Report, April 30, 2012, pp. 40-41.

PROCEDURAL HISTORY

In order to address congestion that exists at the Central East and UPNY/SENY electrical interfaces, and meet other public policy needs, the Commission sought Statements of Intent from transmission owners and other developers proposing projects to increase the UPNY/SENY transfer capacity by approximately 1,000 megawatts (MW).[13] On January 25, 2013, six interested parties offered proposals intended to address the Commission's objectives.[14] Supplemental information related to the Statements of Intent was subsequently requested by the Commission on February 15, 2013.[15]

On February 7, 2013, comments were sought on proposed rule changes to streamline the certification process required by Article VII of the Public Service Law (PSL) and regulations promulgated there under by avoiding the need for future Applicants to seek case-specific routine waivers, and to clarify certain regulatory requirements.[16] On April 22, 2013, the Commission adopted the proposed rule changes under PSL Article VII, with modifications, and established procedures for a comparative evaluation of proposed AC project Applications,

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[13] Case 12-T-0502, Order Instituting Proceeding (issued November 30, 2012), p. 2. A technical conference was held on December 17, 2012, in order to explain the purpose and information requirements for the Statements of Intent, and the process for reviewing specific projects. Case 12-T-0502, Notice of Technical Conference (issued November 30, 2012).

[14] Statements of Intent were filed by: 1) NAT; 2) NYTOs; 3) West Point Partners, LLC; 4) Cricket Valley Energy Center, LLC; 5) NextEra; and, 6) Boundless.

[15] Case 12-T-0502, Notice of Information Requirements (issued February 12, 2012).

[16] Case 12-T-0502, Notice Soliciting Comments (issued February 7, 2013).

while outlining additional procedural steps.[17] The Commission also directed Trial Staff to develop a straw proposal addressing mechanisms for cost recovery, mechanisms for allocating cost-overrun risk between developers and ratepayers, and methods for allocating project costs among ratepayers. Further, the Commission advised that other rule changes might be necessary to facilitate the comparative evaluation and directed Trial Staff to prepare a proposal identifying such changes.[18]

On May 29, 2013, a Notice was issued seeking comments on Trial Staff's proposed procedures to facilitate a comparative evaluation of multiple projects on a common record. Staff also proposed rule changes for how projects that are not subject to Article VII of the PSL would be reviewed, including the content for such applications (collectively, May 2013 Staff Proposal).[19]

On July 10, 2013, a Notice was issued soliciting comments on a separate Staff proposal to address the allocation and recovery of project costs, and mechanisms for allocating

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[17] Case 12-T-0502, Order Establishing Procedures for Joint Review under Article VII of the Public Service Law and Approving Rule Changes (issued April 22, 2013) (April 2013 Order). A two-step review process was established involving the submission of initial application materials, scoping documents, and proposed schedules by October 1, 2013 (referred to as "Part A" application materials), and the submission of the remaining Article VII application materials (referred to as "Part B" application materials) on a schedule to be set by an Administrative Law Judge (ALJ).

[18] On May 14, 2013, Staff hosted a technical conference to discuss the process with potential Applicants and other interested parties and to answer questions. Case 12-T-0502, Notice of Technical Conference (issued April 29, 2013); Case 12-T-0502, Technical Conference Agenda (issued May 10, 2013).

[19] Case 12-T-0502, Notice Soliciting Comments (issued May 29, 2013). On June 17, 2013, Staff convened an additional technical conference to further discuss the process set forth in the April 2013 Order and to answer questions. Case 12-T-0502, Notice of Technical Conference (issued May 31, 2013).

risk between developers and ratepayers (collectively, July 2013 Staff Proposal).[20] The July 2013 Staff Proposal focused on the establishment of a State mechanism for allocating and recovering costs, while recognizing that an alternative cost recovery mechanism might be available pursuant to the NYISO's transmission planning process to address Public Policy Requirements, as approved by FERC.[21]

On September 19, 2013, the Commission addressed the May 2013 Staff Proposal and adopted procedural and substantive rules to help expedite and process proposed solutions. The Commission also directed the assigned ALJs to "consider, promptly after the initial applications are filed, whether an early screening would help streamline the process and serve the goal of obtaining congestion relief at the least cost to ratepayers, and in the 2014-2018 timeframe set out in the Energy Highway Blueprint."[22]

On October 1, 2013, four AC transmission developers (NAT, NextEra, Boundless, and the NYTOs) submitted Part A application materials for consideration. Part A filings identified proposed facility locations, design and operational

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[20] Case 12-T-0502, Notice Soliciting Comments and Scheduling Technical Conference (issued July 10, 2013). The July 10, 2013 notice also advised interested parties of a technical conference to discuss the July 2013 Staff Proposal. The conference was subsequently held on August 1, 2013.

[21] FERC Docket No. ER13-102 et al., New York Independent System Operator, Inc., Order on Rehearing and Compliance, 148 FERC ¶61,044 (issued July 17, 2014). The Commission issued a Policy Statement on August 15, 2014, in Case 14-E-0068, which established generic procedures that would be used to guide the implementation of the Commission's role in the NYISO's public policy planning process.

[22] Case 12-T-0502, Order Adopting Additional Procedures and Rule Changes for Review of Multiple Projects Under Article VII Of the Public Service Law (issued September 19, 2013), p. 11.

characteristics, as well as identification of significant environmental resources in areas potentially affected by the projects. The Part A filings were intended to inform comparative evaluation by Staff of the competing proposals but not require the full range of exhibits required to satisfy the Article VII requirements for full applications. Thereafter, the ALJs analyzed and ruled on deficiencies alleged in the applications. On February 14, 2014, the NYISO filed an initial screening-level analysis of the incremental transfer capability of each project. At a technical conference held on March 19, 2014, the NYISO provided in-depth explanations of its process and results for the initial screening-level analysis.

On February 21, 2014, the Commission stated that it would accept proposals that contribute to the targeted level of congestion relief, even if they do not, individually, provide the full 1,000 MW of additional transfer capability. The ALJs were also directed to establish a process that offers the current Applicants an opportunity to "submit alternatives to their existing proposals, incorporating, to the maximum extent possible, projects that can be contained within the bounds of existing rights-of-way."[23]

The ALJs conducted a telephone conference on February 27, 2014 to discuss the establishment of such a process. Thereafter, on April 10, 2014, the parties were advised by the ALJs that further guidance on the next procedural steps would be forthcoming that would also address how the NYISO cost recovery mechanism for public policy requirements should apply to the ongoing AC Transmission proceeding. After considering various comments and requests for clarification made

[23] Case 12-T-0502 et al., Order Authorizing Modification of the Process to Allow for Consideration of Alternative Proposals (issued February 21, 2014), p. 4.

in the course of these proceedings, Advisory Staff developed recommendations regarding procedural matters, cost recovery, cost allocation, and risk-sharing. On August 13, 2014, a notice was issued seeking comments on certain Advisory Staff recommendations regarding: 1) the procedural steps for evaluating the proposed transmission projects; 2) the mechanism for recovering the costs; 3) the methodology for allocating those costs; and 4) how the risk of cost-overruns should be handled.

On December 16, 2014, the Commission adopted Advisory Staff's recommended procedural steps, with modifications, and identified the Commission's preferred approaches for cost recovery, cost allocation, and risk-sharing.[24] In this same Order, the Commission directed Trial Staff to compare and evaluate the various applications received from the NYTOs (nine scenarios), NextEra (five scenarios), NAT (five scenarios), and Boundless Energy (two scenarios).

Revised Part A Application filings were submitted by the Applicants on January 7, January 19, and March 2, 2015. These Applications provided information regarding the location, preliminary design, and environmental conditions associated with the revised project scenarios. Applicants specified the degree to which each proposal was limited to existing linear ROW or expansion of ROW, or required development of entirely new ROW. Preliminary cost information and descriptions of potential visual impacts were provided. Three of the Applicants provided submittals that reasonably satisfied the Part A filing requirements. Boundless continued to file additional materials through July and August of 2015.

[24] Case 12-T-0502, et al., Order Establishing Modified Procedures for Comparative Evaluation (issued December 16, 2014) (December Order.

On July 6, 2015, Trial Staff filed an Interim Report, which contained a preliminary evaluation of the proposed projects. This analysis included an examination of the existing right-of-way (ROW) use of the proposed projects, the power flow impacts and potential environmental impacts of the projects. It did not contain an analysis of the costs of the projects, or of the Benefit/Cost ratio associated with such projects. Shortly before the issuance of that Interim Report, CPV Valley, a Commission certified generation facility in the Hudson Valley, announced that it had received financing and intended to begin construction in September 2015. Due to the location of this facility in relation to the transmission projects proposed here, Trial Staff determined that it was necessary to undertake further power flow and system impact analyses that included CPV Valley in the base case.

A series of three technical conferences were held on July 20, 21, and 31. Trial Staff and the NYISO presented their respective findings from the Interim Report and received feedback from the applicants regarding those findings during the first two days of these conferences. The third day focused on discussing the costs of the projects. To the extent that Trial Staff's analysis as presented at those technical conferences were in error or otherwise merited modification, such changes are reflected in the analysis contained in this Final Report and Motion to the Commission.

In the December Order, the Commission directed Trial Staff to file a Report and Motion with the Commission regarding a comparative evaluation of the remaining projects based on the following factors:

1. What is the current need for projects to alleviate congestion?
2. Public Policy Transmission Planning Docket Comments

3. How will Non-Transmission Alternatives, including REV affect the proposed designs?
4. Comparative Evaluation of Individual Projects
    a. Transfer Capability
    b. Cost
    c. Electric System Reliability and Economic Impacts
        i. Based on NYISO Power Flow and Multi Area Production Simulation (MAPS) Runs.
    d. How much additional ROW will be needed for each project?
    e. Innovative Technology Used, if any?
    f. Environmental Compatibility.

The evaluation that follows in this Final Report includes examination of each of these factors.

SUMMARY OF COMMENTS

Initial Comments

Nearly 20 parties to these cases filed initial comments on the Part A filings of NAT, NextEra, the NYTOs, and Boundless. The comments below are addressed by Trial Staff throughout the report; the following section is a summary of the general comments, including initial comments, and comments on the interim report and technical conference.

General initial comments were filed by four State agencies, the New York State Department of Environmental Conservation (DEC), New York State Thruway Authority, New York State Department of Agriculture and Markets (Ag&Mkts), and the New York Power Authority (NYPA).

DEC stated that it has concerns regarding proposed projects that would use Thruway ROW because of potential impacts to wetlands and endangered species associated with such uses. Other than the proposals that seek to use Thruway ROW, DEC declined to take a position on any of the proposals and reserved further comments for the prospective Part B Application process. DEC's main comments were focused on ensuring that any Part B Applications contain enough information to allow DEC to conduct a full environmental review in accordance with their regulations.

The New York State Thruway Authority stressed that it has extensive requirements applicable to any construction in the ROW of the Thruway that Applicants must comply with. Specifically, the Applicants would be required to comply with Federal Regulations including but not limited to 22 CFR Part 645 regarding longitudinal accommodation of non-communication utilities. Exceptions from these Federal Highway Administration (FHWA) requirements may be granted, but must be pursued through the New York State Department of Transportation (NYSDOT) and by following the provisions of NYSDOT's "Accommodation Plan for Longitudinal Use of Freeway Right-of-Way by Utilities."[25] This exception policy requires that any non-communications utility demonstrate that all alternatives to the use of controlled access ROW be exhausted before FHWA (and NYSDOT) approval can be granted. This policy in other words, disfavors the use of controlled access ROW, including the Thruway, for use by non-communications utilities. Therefore, any proposed scenario that would use Thruway or other DOT controlled access ROW would have to comply with this policy, including demonstration that no other feasible alternatives exist.

Ag&Mkts' comments expressed concerns that certain required information regarding land use and land control was missing from the Applicants Part A filings. Specifically, that a table identifying potentially impacted lands using specific categories is missing. In addition, Ag&Mkts commented that information across the various proposals was not accurate and the Applicants should amend or supplement their applications with more accurate data. Ag&Mkts also stated that it had concerns over many of the proposed routes that added lines because of possible impacts to farm activities and the resource base. Ag&Mkts is generally in favor of reconductoring activities and the replacement of lattice towers (with large footprint) with monopoles (with smaller footprint) as it would limit the amount of ROW, and thus agricultural lands, to be disturbed and occupied in both constructing and maintaining the transmission facilities.

[25] See, 17 NYCRR Part 131; Case 12-G-0297, Proceeding on Motion of the Commission to Examine Policies Regarding the Expansion of Natural Gas Service, NYSDOT Accommodation of Non-Communication Utilities on New York State Freeway or Controlled Access Rights-of-Way (filed January 9, 2013).

Ag&Mkts stated with respect to NextEra's project Scenario 18 that it would require additional land for ROW and would have specific adverse impacts to dairy farming operations in Montgomery County which support the growing yogurt products industry. Ag&Mkts recommended rejecting Scenario 18. The addition of new structures would create obstacles for farmers who work the land in the areas where the projects are proposed. Ag&Mkts favor use of the Thruway ROW, which would reduce the impact on agricultural lands. These comments also stated that the Edic to New Scotland route, which removes structures, is beneficial whereas the Princetown to New Scotland segment would add structures having a negative impact on agriculture. However, the NextEra Scenarios 16 and 17 had potentially less involvement of agricultural lands than the NYTO Scenarios 11-14. Similarly Ag&Mkts stated that the Knickerbocker to Pleasant Valley route, which would reduce farm impacts by replacing lattice structures with monopoles and the Leads to Pleasant Valley reconductoring, would have less impact on agriculture than projects with new structures. Ag&Mkts stated that the Boundless projects (Scenarios 20 and 21) would have the least impact to agricultural land use since most of the activities proposed are related to reconductoring lines with no new structures proposed.

NYPA stated that some of the projects proposed by the Part A submissions would affect the operation and maintenance of NYPA assets and interfere with portions of NYPA ROW.

Several municipalities located in the Hudson Valley also submitted comments. The Town of Wappinger made general comments that the latest technology should be used to benefit the ratepayer and that the integration of innovative technologies should be paramount in this case to ensure ratepayers receive the maximum long-term benefits from the transmission upgrades.

The County of Delaware submitted general comments that the Part A Applications as filed (Scenarios 1 through 5, 10, and 15 through 19) did not contain enough information to allow for serious investigations into the impacts of the proposed projects through the six towns that it represents. It stated concerns about clearing and widening of corridors, impacts to local infrastructure, impacts of construction activities, changing viewsheds due to increased tree clearing activities, impacts to the New York City Watershed, and the need for flexibility to allow for smart growth. The county requested that each applicant work with the local communities to ensure minimal impact from any project.

The Town and Village of Athens (in Greene County) filed comments similar in nature to those of Delaware County stating that they had insufficient information at this point to determine the impact to their community of the various proposals. The Town and Village also asserted that because so many utility assets already exist in their community that the cumulative impacts of all those assets needs to be evaluated as part of this proceeding. The Town and Village of Athens raised a specific concern about possible overhead construction across the Hudson River and asked that undergrounding of the lines across the river be considered in lieu of new construction or replacement of existing structures. Also raised in their comments was the need for new transmission lines given other proposed action within the State such as the REV proceeding.

Dutchess County also submitted comments with respect to whether there is a continued need for transmission upgrades, the associated costs to consumers, and the environmental impacts to the County of the proposals. Dutchess County stressed the need to evaluate other proceedings, especially REV, to determine whether new transmission is needed. In addition, Dutchess

County stated that since transmission lines have such a long service life particular attention needs to be paid to protecting viewsheds for generations to come. Dutchess County noted specifically that REV's goals of implementing real time pricing and allowing non-transmission alternatives to drive down the need could forestall future transmission investments. The County is concerned about the high costs of transmission upgrades being passed on to consumers without them receiving the direct benefits in terms of price reduction. Dutchess County, as part of the Hudson Valley Smart Energy Coalition (HVSEC or the Coalition) supports the comments submitted by the Coalition.

HVSEC - the coalition of municipal and environmental groups - submitted extensive comments that generally discussed the need, cost, and environmental impacts of the proposed projects. In addition HVSEC included charts ranking the projects from low to high impact in each category. HVSEC's general comments were similar to other municipalities and environmental groups in that they stressed the need to evaluate non-transmission alternatives and whether there is in fact congestion that transmission solutions can alleviate. HVSEC believes that the Thruway alternatives will have the most negative visual impacts and that reconductoring projects should be preferred over those using new ROW. HVSEC commented on the need to properly evaluate environmental impacts to the region and that the Commission's benefit costs analysis should be robust.

Scenic Hudson also filed comments. These comments provided a detailed listing and analysis of Hudson Valley resource impacts potentially resulting from the various scenarios. Visual, historic, land use, natural resource and conservation of agricultural and important habitat areas are described at length in the comments.

The Town of Saugerties commented that any project that proposes to use Thruway ROW will have a significant impact on the Town. Any proposed use of the Thruway will impact the Town's Open Space Plan and might impact a historical viewshed including locations that are significant to the Hudson River School of Art and Hudson Valley National Heritage Area viewshed corridor.

One individual, Edwin Pell, submitted comments that any decommissioned lines that result from transmission upgrades be converted into green-ways for the enjoyment of New York residents.

The Otsego County Conservation Association, Inc. (OCCA) in collaboration with Otsego County filed extensive comments on NAT's proposals to build new facilities (Edic-Fraser) adjacent to the NYPA Marcy South line in Scenarios 1 through 5 with respect to the following categories: Economic Impacts, Local Ordinances, Communications, and Transportation. With respect to the economic impacts of the NAT projects, the comments stated that the NAT proposal is deficient and the economic analysis performed by NAT relies on incorrect methodologies and assumptions. It asks that in any Part B application NAT be required to include an updated economic impact study using current economic information and industry accepted methodologies. OCCA and the County also stated that in the Part B Application NAT should be required to show not only that any project would comply with local ordinances but also how the project would comply with each affected municipality's Comprehensive Plan and Local Waterfront Revitalization Program (LWRP) if applicable. With respect to Communications, the OCCA and the County asked that any NAT Part B Application be required to show how the Edic to Fraser line will affect or interfere with various communication systems such as radio, television, and cellular systems. OCCA and the County also requested that any Part B applications contain Traffic Impact Studies and Loss of Service analysis related to any activities that will affect transportation systems.

OCCA also filed on behalf of a coalition of environmental groups based in Otsego County including Otsego Land Trust, Otsego 2000, Inc., the Butternut Valley Alliance, and the Delaware-Otsego Audubon Society. OCCA filed an extensive report outlining the impacts of the proposed Edic to Fraser project to inform the public record and evaluate the projects compatibility with the environmental and community characteristics of Otsego County. The report outlined the concerns of OCCA in relation to need and public benefit, siting, alternative proposals, environmental impact, other impacts, compliance with local laws, and community outreach conducted by OCCA. The report is extensive and not conducive to summary and is available on the Commission's website for review.

The Town of Wappinger made specific comments regarding the Boundless proposals and stated that Boundless neglected to mention that its undergrounding activities and Hudson River crossing as proposed will be located near the proposed NYC Delaware Aqueduct Bypass Tunnel. The Town of Wappinger stated that any activity related to the Boundless proposal should not interfere with the proposed NYC Delaware Aqueduct Bypass Tunnel, and asked that Boundless set forth a plan to insure that any transmission upgrades will not interfere with the proposed tunnel. The Town of Wappinger also stated that Boundless makes no mention of other potential utility crossings in its proposal. In light of these omissions the Town asks that the additional information about these deficiencies be reviewed before Boundless submits any Part B application.

Reply Comments

Each of the Applicants submitted comments on the Part A Applications. Each of the Applicants stated why their projects were better suited to meet the requirements of the Commission than those of the other Applicants for either technical or practical reasons. Those aspects of the Applicants' comments will not be summarized here but are part of the record and are available for review. We will summarize other aspects of the Applicants' reply comments here, namely, their comments on cost estimates, both for their own projects and those of the others, and their responses to the intervenor comments.

Cost Estimates

In its reply comments, Boundless claims that its Leeds Path West is one of the lowest cost proposals because it seeks to rebuild the existing system and not build new facilities. Boundless argues that it is the least cost alternative because its proposal "stands alone in focusing on fixes to the existing system while concurrently providing important enhancements of high technical value but low social and environmental impact." Boundless argues as a result of this that the cost estimates of "new build" portions should be compared which would yield a highly favorable benefit/cost ratio for Boundless.

Boundless also states that NextEra's cost comparisons are "artificial and should be disregarded" because NextEra only reviewed a portion of the Boundless project for cost comparison purposes. Boundless claims to be the only project to include SRIS and included future upgrade costs in its proposal. Finally, Boundless claims that NYTOs' and NAT's proposals should be given a lower rating because of their high estimated costs.

It its reply comments, NAT responds to Boundless' claim that their project estimates were incorrect. Boundless claimed that NAT's proposals would have higher costs, more environmental impacts and affect more residences. NAT points out that their submission is not an "all or nothing" project but rather an assemblage of components, any of which could stand alone to mitigate cost or environmental concerns.

NAT filed initial comments on the Part A submission in which it claims that many of NextEra's cost estimates were too low and that other aspects of the projects costs were improperly omitted. For example, NAT states that NextEra did not include the costs associated with sectionalizing the 115-kV line for its removal which would reduce the impacts of construction activity, but increase costs.

On May 12, 2015 NAT filed an objection to certain reply comments claiming that the comments were in fact not comments but improper attempts by other Applicants to modify their respective cost estimates. NAT claimed NextEra in particular filed reply comments in order to make their project more competitive with NAT's from a cost standpoint. NextEra also filed an objection to NAT's reply comments claiming that contained within NAT's comments was an attempt to amend its bid. Both NextEra and NAT claimed that the attempted modification was contrary to the Commission's Orders.

NextEra further claimed in its reply comments that some cost estimates were not included in the NYTOs estimates, including upgrades to the 115-kV Switchyard at the Rotterdam Substation. The NYTOs responded that this work is a planned system upgrade and thus not included since it would be completed regardless of the outcome of this proceeding. NextEra also claims that the conductor size proposed by the NYTOs is too small and will lead to a reduction in power flow and thus increase the total costs of operation. The NYTOs responded with their own calculations indicating that NextEra's calculations were incorrect. The NYTOs also responded to Boundless' claims that the most expensive projects were those of the NYTOs by pointing out that Boundless did not provide information capable of producing an apples-to-apples comparison of project costs.

Responses to Intervenor Comments

In response to the HVSEC comments, which state that there is no need for transmission projects in general, the NYTOs responded that there is a need for three reasons: 1) congestion 2) gaining infrastructure; and 3) the hindrance of renewable development. The NYTOs argued further that changes in generation portfolios due to shifting regulatory and market landscapes make the need for upgraded transmission between UPNY and SENY even more important and cost effective. The NYTOs also responded to several comments from both HVSEC and Ag&Mkts about maintaining the use of agricultural lands, by stating that lattice towers occupy more space than the monopoles proposed, which should allow for more space for agricultural activities. The NYTOs responded to the Town and Village of Athens concerns regarding the visual impacts of the proposed Hudson River crossing by stating that the proposal doesn't increase the number of crossings and that it is too soon in the process to know what impacts there will be from any construction activities. The NYTOs responded to Delaware County that they will try to minimize impacts during construction.

Boundless responded to HVSEC's comments by stating its support for the proposition that the best proposal would be one that met the initial 1,000 MW criteria, in the least cost manner, without increasing ROW usage, and that had the fewest environmental and visual impacts. Boundless claims that its project proposals best meets these criteria.

In its reply comments, NAT pointed out that the vast majority of comments from other parties and Applicants were devoted to the potential future Part B process and information that needs to be included in that part of the application, information that the Commission has not yet asked for. For instance, as stated above, DEC stated that it would like the Applicants to ensure that wetlands are mapped appropriately. NAT also specifically addresses a number of intervenor comments. NAT wanted to correct an error that the Town and Village of Athens had made in their initial Part A comments, namely that it was NextEra's proposal that required a new corridor between I-87 and the Leeds Substation, and not the NAT proposal which would simply expand existing ROW.

OCCA commented that they would like to see information related to "open space and recreation impacts" to historic properties that NAT claims have not yet been evaluated for listing in the State or National Registers. NAT stated that some of the information OCCA requested would have to come in the form of a Part B Application not a Part A Application, but noted their continued commitment to call upon local resources in addressing project related issues. In particular NAT wanted to point out that it had previously changed its proposed route as a result of meeting with the Otsego Land Trust.

NAT also discussed the various comments focused on the expansion of ROW and points to Commission language that states that to the degree possible Applicants should minimize both the acquisition of additional lands for ROW use and the construction of major electric transmission facilities that are out of scale or character with existing facilities already in the landscape.[26] NAT stated that it believes the Commission's objectives were to limit, but not exclude entirely, the expansion of ROW in achieving the Commissions objectives in this proceeding. NAT also responded specifically to Delaware County's concerns regarding the expansion of ROW to 80 feet and the attendant needs for maintaining such an expansion.

Post Interim Report Comments & Letters

Following the issuance of the Interim Report, each of the Applicants as well as other parties filed letters and comments with Trial Staff regarding the analysis contained in the Interim Report. These comments and letters contain too much detail to be effectively summarized here. They generally pointed out what the Applicants viewed as flaws in Trial Staff's analysis. Trial Staff analyzed these concerns and made changes to its assumptions and other analysis as appropriate. To the extent that Trial Staff has made any changes to its analysis in response to these filings, they are noted in this Final Report.

[26] December 16th Order, at 39.

SCENARIO DESCRIPTIONS & GENERAL INFORMATION

The four Applicants in this proceeding have proposed 22 distinct scenarios. A complete list of these scenarios along with identifying numbers and cost estimates for each is listed in the table below (a map graphically depicting these scenarios is also attached as Appendix 1).

Figure 3: Applicant Proposed Scenarios with Applicants' Costs

#	Sponsor	Scenario	Cost Estimate*
1	NAT	ED-FR; NS-LD-PV	$668,750,000
2	NAT	ED-FR; NS-LD-PV Alt 1	$864,750,000
3	NAT	ED-FR; NS-LD-PV; sc at FR; connect M-CC to FR	$710,208,000
4	NAT	ED-FR; NS- PV Alt 2; sc at FR; connect M-CC to FR; sc at M; sc at ED	$1,077,291,000
5	NAT	ED-FR; NS-KN-PV Alt 2; sc at FR; connect M-CC to FR; ED-PR-KN as proposed by others	$1,033,459,000
6	NYTOs	KN-PV	$616,973,842
7	NYTOs	LD-PV(R)	$359,331,390
8	NYTOs	HA	$242,082,849
9	NYTOs	NS-LD(R); LD-PV	$635,172,770
10	NYTOs	O-FR; ED-NS; KN-PV	$1,404,610,880
11	NYTOs	ED-NS; KN-PV	$1,194,071,098
12	NYTOs	ED-NS; NS-LD-PV(R)	$1,104,641,757
13	NYTOs	ED-NS; HA	$848,286,806
14	NYTOs	ED-NS; NS-LD(R); LD-PV	$1,228,635,727
15	NextEra	Thruway ED-LD-PV	$735,117,633
16	NextEra	Marcy Southern 1 (M-PR-R;GB-KN-CH-PV)	$701,699,107
17	NextEra	Marcy Southern 2 (M-PR-R;PR-NS-KN; GB-KN-CH-PV)	$842,722,379
18	NextEra	Marcy Northern (M-OH-NS; GB-KN-CH-PV)	$657,227,913
19a	NextEra	GB-KN-CH-PV	$386,137,312
19b^	NextEra	O-FR	$386,137,312
20	Boundless	LD-HA(R); Athens Generating-LD-PV(R); CPV-RT(R); RS-EF; sc LD-HA-RS;	$263,160,114
21	Boundless	LD-HA(R); CPV-RT(R); RS-EF; sc LD-HA-RS; sc NS-LD	$736,715,587

sc: Series Compensation Equipment
sr: Series Reactor
(R): Reconductoring
* These are the initial cost estimates as filed by the Applicants including certain universal additions common to all projects. Trial Staff's analysis resulted in different cost estimates, discussed below, along with the universal additions.
^ Following the Technical Conferences, Trial Staff removed O-FR from all NextEra scenarios and analyzed it as a standalone proposal.

General Information Regarding Proposed Scenarios

The following information is put forward so that all parties can better understand Trial Staff's environmental review. There are five basic methods of installation proposed by the Applicants for the 22 scenarios. These methods include creation of new ROW, expansion of existing ROW, replacement of existing facilities with new facilities, reconductoring, underground installation including trenching, and underground installation including horizontal directional drilling (HDD).

Creation of New ROW

Creation of new ROW refers to project segments that will not utilize any portions of existing ROW. Projects incorporating this method of installation will establish wholly new ROW along land not currently used as utility, highway, or railroad ROW. This method will require property acquisition, vegetation clearing, construction of access roads, and installation of transmission towers and conductors. Depending on the nature of the area, potential impacts may affect forest, streams, wetlands, agricultural land or other land uses. Installation of new transmission towers will require significant construction equipment and labor activities at each location. If installation requires concrete foundations, additional construction equipment will be needed on-site, as these foundations involve significant excavations, spoil hauling, and concrete pouring operations. Upon installation of transmission structures, stringing of new conductor is also required. During the stringing activity, two control areas referred to as pulling stations are utilized for installation techniques within a pulling section. Both control areas will be cleared for housing tension machines, large cable spools, trucks and vehicles, and other necessary equipment. Numerous pulling station sites are required for long stretches of transmission ROWs. Specific impacts regarding individual scenarios proposing new ROW will be further explored in the scenario descriptions in this document. This is the most disruptive method, as it involves development of land not currently used for utility, highway or railroad ROW and significant construction activities associated with structure installations.

Expansion of Existing ROW

Expansion of existing ROW refers to the widening of an existing utility, highway, or railroad ROW. A project using expanded ROW will typically require property acquisition, vegetation clearing and grading. Forests, streams, wetlands, agricultural land, and other land uses could be impacted during installation. However, it may not necessarily require construction of entirely new access roads, as portions of the existing access roads may be utilized, where appropriate. There will be a need to build sufficient access road extensions to reach the new transmission towers that may involve clearing and grading operations. Installation of towers will still be required, but may not be as impactful as when installed in entirely new ROW, due to the possible use of existing cleared land (for work space) associated with the existing ROW. Stringing and tensioning the conductors, as described previously, is also required for this method. Therefore, this method consists of some impacts, but is generally not as disruptive as the creation of new ROW.

Reconductoring Method

Reconductoring is the removal of old and installation of new power conductors on existing transmission structures. As with expansion of existing ROW, previously cleared land and access ways may be utilized for work spaces and access roads. Typically, the only construction activities required for this method include removal of old conductors and the stringing of new conductors, as described above. Some towers will require replacement to meet structural requirements for new conductor attachment or to meet clearance requirements for the 345 kV transmission lines. If structures require replacement in the Hudson River, construction of new foundations and removal of the old foundation would result in significant environmental impacts similar to new construction.

Replacement of Existing Facilities

Several proposals call for the replacement of existing transmission facilities with new equipment, including the replacement of single- or double-circuit facilities with higher voltage or additional circuits. Existing transmission towers and conductors would be removed, and new lines would be installed in replacement of the old facilities. Existing ROW and access roads would be used, limiting new land area additions, although access road upgrades may be necessary to accommodate heavy construction equipment, and for removal of existing components and delivery of large transmission structure components.

Trenching and Horizontal Directional Drilling (HDD)

Underground construction of 345 kV transmission lines is a component of the scenarios proposed by Boundless and NextEra. Construction of underground transmission requires large excavation for the duct bank trench and splice boxes. The duct bank is concrete encased and requires a trench that is eight to ten feet wide (or more) and six to eight feet deep (or more). The splice boxes are normally pre-cast concrete that require excavations that are deeper and wider than the trench that holds the duct bank. Underground construction is slow and requires complex environmental management due to the amount of soil disturbance. Excavation in bedrock conditions can add to the extent and duration of construction and site restoration activities.

The proposed scenarios include limited underground installation at various locations to cross underneath the Hudson River. The HDD method is a trenchless installation method that consists of installing conductors underground via drilling or boring equipment. Two temporarily cleared areas are needed for this type of installation: the receiving pit and entry/staging area. The directional drilling unit and associated pumping equipment occupies the majority of the staging area. Aside from these areas, there are virtually no other permanent impacts for this type of installation as the conductors are buried underground, beneath a highway, railroad or major water body.

HDD installation requires use of lubricating drilling muds composed of clay, water and surfactants to improve the characteristics of the mud. Where HDD installation is proposed at water body crossings, it may be done at a depth of at least ten feet below dredging depths of the water body or much deeper depending on the alignment of the bore. The drilling muds are normally contained in the bore hole and the discharge of the mud, if there is breakout, has to be managed to limit the discharge. The drilling mud may damage aquatic habitats in the same way that any other sediment would degrade water quality and harm aquatic plants or animals.

Man holes and splice pits may be required along portions of underground conductors, to accommodate wire pulling and conductor connections.

Water Body Crossing Methods

There are four basic water body-crossing methods proposed for the 22 scenarios, new aerial crossing installation, HDD below water bodies, reconductoring of existing crossings, and bridge attachment. New aerial crossings will create new visual impacts and new construction disturbance. Reconductoring by use of existing or in-kind replacement structures or bridge attachments should result in minimal land disturbance, although there may be some habitat disruption at Hudson River shoreline areas.

General Information Regarding Environmental Review

Trial Staff evaluated environmental factors for each of the 22 scenarios proposed by the Applicants. The review was based primarily on the information provided by each of the Applicants in their January 7, 2015; January 19, 2015; and March 2, 2015 Part Application Filings. The differences in how information was presented by the Applicants with respect to environmental and land-use made it difficult to compare these projects using unified criteria. In preparing the Interim Report, where informational gaps existed in one or more of the Part A Application Filings, Trial Staff performed limited desktop analyses to develop a more extensive data set that covers a broad range of environmental factors. However, it should be noted that where Trial Staff was required to perform its own analyses, these analyses are based on Trial Staff's knowledge and experience in siting and construction of similar electric transmission facilities. Trial Staff's assessment of potential impacts may diverge from a particular Applicant's when, based on Trial Staff's experience or particular resource considerations, greater impacts are readily anticipated. For this Final Report, Trial Staff has relied entirely on Applicant provided data.

For example, some of the projected impacts reported by the various Applicants were not described in a consistent manner between similar proposals that would occupy the same ROW. NextEra proposed a 110-foot wide ROW to estimate impacts for scenarios 16, 17 and 19. Conversely, NYTOs evaluated impacts by assessing the entire existing ROW width for Scenarios 10, 11, 12, 13, and 14. The land-cover area estimates provided by NextEra and NYTOs, between projects within the same ROW, are not consistent because ROW widths evaluated by the NYTOs varied from 400 to 1,000 feet in the Oakdale to Fraser ROW and 100 to 590 feet in the Edic to New Scotland ROW. The NextEra land-cover area, based on a 110-foot ROW width, represents only the portion of the existing ROW expected to be utilized for the proposed project, whereas, the NYTOs estimate represents the entire width of the existing ROW. Trial Staff advises that the extent of direct impact on the NYTOs' ROWs would be less than those full widths of 200 feet or more.

Another source of variability is the base information used by the Applicants. The NYTOs' application used in-house mapping and included more detailed data regarding the positioning of facilities within existing ROW and the position of the transmission towers, while NAT, NextEra and Boundless compiled ROW locations and positioning of facilities within the ROWs using publicly available property information and aerial photography. The differences in the various information sources contributed to the variability of the identified environmental characteristics.

The various components of the scenarios are described in detail below and in Table 1, Comparative Environmental Impacts. Trial Staff's comparative ranking criteria are more fully described in the Environmental Impact, Analysis, and Ranking sections of this report as well as in Table 2, Comparative Ranking Criteria. Tables 1 and 2 are attached to this report.

Following the issuance of the Interim Report and Technical Conferences, parties to this case provided comments in both oral and written form. In response to comments received from parties during the technical conference, Trial Staff revised Tables 1 and 2. The revised tables reflect the recommendations made by the applicants and verified by the Trial Staff, and Trial Staff's further consideration and evaluation of the methods utilized for evaluation of environmental data. The new information required that ratings for the individual parameters be updated since the additional information caused changes in the statistical values. As noted in Table 2, the environmental parameters rankings were established by calculating the average (mean) for each measurable factor. The medium rank ranges represent half of a population standard deviation on either side of the calculated mean. Low rankings were assigned to values less than the medium rank range and high rankings were assigned to values greater than the medium rank range.

The rankings for each environmental factor shown in Table 2 of the Interim Report reflect Trial Staff's decision to ignore data values of zero; including zero values would cause the calculated means to decrease (the devisor becomes larger yet the sum of the values do not change). The decision to exclude zero values from calculation of the means and standard deviations reflected Trial Staff's concern that zero values would skew the data and inhibit comparisons of scenarios with non-zero values. However, after further consideration of its analytical methods following the Interim Report, Trial Staff determined that in this case the zero values are data representing projects that will not require new land and should not be excluded from the calculated means and standard deviations. It should be noted that the data for each category in Scenario 8 were not included in the calculations because Scenario 8 is a non-transmission proposal.

The ranking ranges in Table 2 of the Interim Report reflect Trial Staff's calculation of the standard deviations for each quantitative environmental factor using a sample standard deviation methodology. A sample standard deviation is appropriate when the data set does not define the entire population, but rather is a representative sampling of a larger group of data. An alternative approach is used in the final report. The ranking ranges in Table 2 of the Final Report reflect Trial Staff's calculation of the standard deviations for each quantitative environmental factor using a population standard deviation methodology. The population standard deviation calculations include the zero values previously excluded in Trial Staff's calculations. A population standard deviation is appropriate when the data set represents the entire data population.

The changes in Trial Staff's methods for statistical analysis, as well as updates to the data provided by the Applicants, resulted in changes to the ratings ranges for each of the environmental parameters. The changes in the parameter ratings are most significant for those environmental parameters containing the highest number of zero values: "New ROW", "Expansion ROW", and "Total New and Expanded ROW". Because of this change in methodology, some of the scenarios that require New ROW or Expansion ROW that had Low ratings now have ratings of High in those parameters. Projects that do not include New or Expansion ROW continue to have Low ratings for those parameters. This shift in rating reinforces the qualitative logic that projects with no new and/or expanded ROW land commitments are more environmentally compatible than projects that require new land acquisition. For example, in the Interim Report, projects that had 0-10.7 miles of New ROW were rated as low, while it is clear that a project with zero miles of new ROW land commitment is measurably less impactful than a project requiring 8-10 miles of new ROW clearing and development.

The NextEra Oakdale - Fraser project (Case 13-T-0456) is now identified as a separate scenario 19B. Removing the Oakdale - Fraser segment from each of the NextEra scenarios changed the total values of physical characteristics and thus revisions to averages and standard deviations used in developing the impact ratings, as reflected in Tables 1 and 2 . NextEra clearly stated that its intentions were that the Oakdale - Fraser project was independent of the other four scenarios between Marcy and Pleasant Valley, and East Greenbush to Pleasant Valley. The prior Trial Staff analysis had linked Oakdale - Fraser to each NextEra scenario.

General Information Regarding Substations and Equipment Located in Substations

The majority of the proposed project scenarios would require the installation of new or upgraded substation equipment. These proposals, however, are preliminary and do not provide sufficient engineering information for a complete review. The Applicants have not provided studies to allow Trial Staff to determine the size or design parameters of any transformers or emergency generator(s) that would need to be installed. Similarly, the positions of breakers and line terminations have not been identified in sufficient detail to allow Trial Staff to determine their size and important operating characteristics. Further material associated with any project or projects selected by the Commission to proceed to Part B filings should include this information.

General Information Regarding Cost Estimates

Most of the cost estimates filed by the Applicants failed to fully address environmental compliance costs associated with construction of access roads, or construction through farm land and wetlands. Following an initial exchange of information at the Technical Conferences, and in order to evaluate the scenarios on a level playing field, Trial Staff calculated cost estimates that included these costs. Each project was evaluated by Trial Staff assuming that the same number of miles of roads and matting would be required for projects using the same rights-of-way. These calculations are included in Trial Staff's detailed cost estimates below.

Costs associated with NYISO-required system upgrade facilities that would be necessary for project operation were also largely missing from Applicants' cost estimates. As in every case where a generator or utility builds a new transmission line, the operator of the new facility is required to pay for any system upgrades required for the project to be maintained as operational. If a project will affect another transmission operator's short circuit capability and equipment, the installer of the new equipment must pay for the necessary system upgrades. Based on its extensive experience, and in order to evaluate the 21 scenarios on a level playing field, Trial Staff developed estimates that include these costs. Identical estimates for this work were added by Trial Staff to each Applicant's filed estimates.

Some Applicants also included contingency estimates, and an estimated Allowance for Funds Used During Construction

(AFUDC) figure in their cost estimates. Trial Staff deleted these costs since they are part of the revenue requirement modeling completed by Brattle. The NYTOs cost estimates were submitted in 2014 dollars. All cost estimates compared in this analysis have been normalized to 2015 dollars.

Finally, Trial Staff made a series of “Global Additions” to the estimates put forward by NAT, the NYTOs, and NextEra. These Global Additions include an upgrade of the Chester-Shoemaker Line as well as Rock Tavern Terminal Upgrades and a 30% contingency. The Shoemaker-Chester-Sugarloaf upgrades and Rock Tavern Terminal Upgrades were identified by the NYISO as being necessary in order for the proposed projects to result in a system benefit, these upgrades are discussed in detail below.

Trial Staff recognizes that there are discrepancies between its cost estimates and those provided by the Applicants therefore, both sets of estimates are presented below, as well as in the attached analysis by Brattle, so that the Commission may evaluate the projects using either the Applicants’ bids, or those based on Trial Staff’s estimates: Trial Staff maintains that its estimates more accurately reflect the true cost associated with constructing major transmission projects in New York. Finally, Trial Staff notes that in conducting its review and winnowing certain scenarios from consideration it did not base any such winnowing on its cost analysis alone due to the uncertainty regarding the proper cost estimates. Trial Staff’s recommendations are however based in part on Brattle’s benefit/cost analysis, which is presented using both sets of cost estimates (including the Global Additions).

NAT Scenarios and Impacts

NAT proposed five scenarios for consideration. The scenarios include the following three primary features:

1. New 345-kV circuit connecting the existing Edic and Fraser substations;
2. New 345 kV circuit connecting the existing New Scotland and Pleasant Valley substations; and
3. Various components intended to improve transfer capability of the existing electric transmission system without requiring additional lands for ROW.

The five scenarios proposed by NAT are described as follows.

Scenario 1: ED-FR; NS-LD-PV

Scenario 1 includes two project components. The Edic to Fraser (ED-FR) component consists of a new 345 kV single circuit overhead transmission facility originating at the existing Edic Substation, located in the Town of Marcy, Oneida County, proceeding generally south, and terminating at the existing Fraser Substation, located in the Town of Delhi, Delaware County. For more than 90 percent of its 80 mile length, the ED-FR component will parallel NYPA's existing Marcy-South electric transmission facility. This component will include series compensation equipment at the Edic Substation. NAT proposed to use a "vertical" monopole configuration where the facility is parallel to existing infrastructure and a "delta" configuration where new ROW is proposed. According to NAT's Part A Filing, typical "vertical" tangent monopoles will be 125 feet tall and cables will be configured on the same side of the structure. Typical "delta" tangent structures will be 105 feet tall and the cables will be configured on both sides of the structure.

The ED-FR 345-kV electric transmission facility proposed by NAT will require the procurement and clearing of new ROW along the entirety of its length. Where the proposed facility will parallel NYPA's existing Marcy-South electric transmission facility an 80-foot wide ROW expansion adjacent to the existing NYPA ROW will be required. The remaining length of the proposed ED-FR facility will require new 100 foot wide ROW. The proposed line will include new overhead crossings of the Mohawk River and Erie Canalway and clearing of forest vegetation near the canal crossing, conflicting with provisions of the Canalway Preservation and Management Plan, and incrementally affecting viewsheds within the Erie Canalway National Heritage Corridor.[27] The NAT facility design will also result in visual contrasts with the adjacent existing NYPA facilities through Herkimer, Otsego and Delaware Counties. The NYPA facilities were sited and designed to minimize visual impacts based on an extensive record in PSC Article VII Case 70126.[28] A variety of mitigation measures -- including several structure types -- were used based on facility location, whereas NAT proposes to use monopole designs for the length of its proposal.

The New Scotland to Leeds to Pleasant Valley (NS-LD-PV) component consists of a new 345 kV single circuit overhead transmission facility originating at the existing New Scotland Substation, located in the Town of New Scotland, Albany County, proceeding generally south and connecting to the existing Leeds

[27] Erie Canalway National Heritage Corridor Commission, Erie Canalway National Heritage Corridor Preservation and Management Plan, 2008; http://www.eriecanalway.org/about-us_preserve-manage.htm#sthash.8LrX1Sme.dpuf

[28] Case 70126, Power Authority of the State of New York – Marcy-South 345 kV Transmission Facilities, Opinion and Order Granting Certificate of Environmental Compatibility and Public Need (issued January 30, 1985).

Substation, located in the Town of Athens, Greene County. From the Leeds Substation the proposed facility will proceed generally southeast and connect to the existing Pleasant Valley Substation, located in the Town of Pleasant Valley, Dutchess County. The proposed alignment of the NS-LD-PV component is approximately 65 miles in total length, 55 miles of which would adjoin and be parallel to the existing National Grid 345-kV electric transmission ROW. NAT proposed to use a "vertical" monopole configuration for a majority of the NS-LD-PV 345 kV facility. Where the facility will cross the Hudson River parallel to National Grid's existing 345-kV and 115-kV transmission lines, NAT proposed to use lattice steel structures in order to conform to the scale, form, line, color and texture of the existing adjacent structures.

The NS-LD-PV 345-kV electric transmission facility proposed by NAT will require procurement and clearing of new ROW along the entirety of its length, approximately 65 miles. The project will require an 80 foot wide expansion of an existing 345-kV electric transmission facility ROW for approximately 55 miles and 100 feet of new ROW for the remaining 10 miles. Additional considerations of Hudson Valley visual resources are included below in section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations*, below.

Scenario 2: ED-FR; NS-LD-PV Alt 1

Scenario 2 includes two project components proposed by NAT. A description of the ED-FR component was provided in the discussion of Scenario 1 above.

The New Scotland to Leeds to Pleasant Valley Alternative 1 (NS-LD-PV Alt 1) component is a new 345 kV single circuit overhead electric transmission facility originating at the existing New Scotland Substation. The facility would be parallel to the existing CSX railroad ROW southeasterly for approximately eight miles, then proceed generally south within the I-87 New York State Thruway (Thruway) corridor, leaving the Thruway to connect to the existing Leeds Substation in the Town of Athens, Greene County. From the Leeds Substation, the NS-LD-PV Alt 1 component will re-join the Thruway I-87 ROW and proceed further south to the Town of New Paltz. The total distance that the line will be sited within the I-87 Thruway ROW is approximately 55 miles. From the I-87 corridor in New Paltz, the facility will proceed east along new ROW for approximately 14 miles to the Pleasant Valley Substation.

The NS-LD-PV Alt 1 will occupy existing I-87 ROW for approximately 62 percent of its length and the remaining 38 percent of its length will be new ROW. The proposed ROW will be located within 100 feet of 25 existing residences and 30 existing residential structures (barns, garages and swimming pools) are located within the proposed ROW. Transmission poles would be placed in scenic areas of the Thruway and be out of scale with the existing generally low-profile highway. This alternative will require a new overhead electric transmission facility crossing of the Hudson River and new electric transmission ROW through both the National Park Service's Franklin D. Roosevelt National Historic Site and the Eleanor Roosevelt National Historic Site. The NS-LD-PV Alt 1 component is out of character for the area and with existing land uses and facilities. Use of the Thruway ROW would require conformance with the numerous utility accommodation provisions of Federal Highway Administration and New York State Department of Transportation, as described further below. Additional considerations of Hudson Valley resources are included below in section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations*.

Scenario 3: ED-FR; NS-LD-PV; Series Compensation on FR-G; Loop Existing M-CC 345 kV to FR

The ED-FR and NS-LD-PV 345 kV electric transmission facilities proposed by NAT are summarized in the descriptions of Scenario 1.

NAT proposed series compensation on the existing Fraser to Gilboa (FR-G) 345 kV circuit at Fraser Substation. According to NAT, the proposed series compensation could enhance transfer capability and will not require acquisition of additional lands for ROW.

Additionally, NAT proposed to connect the existing Marcy to Coopers Corner (M-CC) 345-kV circuit to the existing Fraser Substation. The M-CC loop will be constructed entirely within existing ROW and will not require acquisition of additional lands. NAT failed to provide a description and details of the proposed facilities and construction methods for this line segment.

Scenario 4: ED-FR; NS-PV Alt 2; Series Compensation on FR-G; Loop Existing M-CC 345 kV to FR; Series Compensation on M-NS; Series Compensation on ED-NS

A description of the ED-FR component was provided in the discussion of Scenario 1.

The New Scotland to Pleasant Valley Alternative 2 (NS-PV Alt 2) component is a new 345 kV single circuit overhead electric transmission facility originating at the existing New Scotland Substation. The facility would be parallel to the existing CSX railroad ROW southeasterly for approximately eight miles, crossing the Hudson River, then proceed generally south within the existing National Grid

Greenbush to Churchtown (GB-CH) and Churchtown to Pleasant Valley (CH-PV) 115 kV corridors for the remaining 54 miles to the Pleasant Valley Substation.

The NS-PV Alt 2 component will require removal of the existing 115-kV transmission structures in the portions of the GB-CH and CH-PV ROW where the facility would be located and reinstallation of the existing 115-kV and new 345-kV circuits on new multiple circuit structures. NAT proposed to use a “vertical” monopole configuration where the facility is parallel to the existing CSX railroad ROW and multiple (three) circuit horizontal H-frame structures where the facility will be located within the existing 115 kV ROW. The proposed heights of the multiple circuit horizontal H-frame structures will be no greater than the heights of the existing structures within the 115 kV ROW and the facility will not require expansion of the existing GB-CH and CH-PV 115 kV ROW. NAT’s proposed design does not appear to take into account an existing National Grid gas transmission facility located within the GB-CH ROW. This gas facility may complicate design and location of the facilities proposed for this scenario. Additional considerations of Hudson Valley resources are included below in section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations*.

The M-CC 345 kV circuit component is addressed in the discussion of Scenario 3.

Scenario 4 includes the following series compensation projects:

1. Series compensation on the existing FR-G 345 kV circuit as described in the description of Scenario 3;
2. Series compensation on the existing M-NS 345 kV circuit at Marcy Substation, located in the Town of Marcy, Oneida County; and
3. Series compensation on the existing ED-NS 345 kV circuit at Edic Substation.

According to NAT, the proposed series compensation could enhance transfer capability and will not require acquisition of additional lands for ROW.

Scenario 5: ED-FR; NS-KN-PV Alt 2; Series Compensation on FR-G; Loop M-CC 345 kV; ED-PR-KN Circuit as Proposed by Others

A description of the ED-FR component was provided in the discussion of Scenario 1.

The New Scotland to Knickerbocker to Pleasant Valley Alternative 2 (NS-KN-PV Alt 2) component adds a connection with a proposed Knickerbocker Switchyard facility, located in the Town of Schodack, Rensselaer County, to the NS-PV Alt 2 component described in the discussion of Scenario 4. The Knickerbocker Switchyard facility will be constructed by NAT on existing property owned by National Grid. Because the existing 115 kV ROW passes through the proposed Knickerbocker Switchyard location, no additional line routing will be required for the connection. A description of the NS-KN-PV Alt 2 route is included in the discussion of Scenario 4 (see description of NS-PV Alt 2 component).

The M-CC 345 kV circuit component is addressed in the discussion of Scenario 3.

NAT also proposed an Edic to Princetown (Schenectady County) to Knickerbocker project component (as proposed by others). However, NAT failed to provide any description or details of the environmental impacts of this proposal.

NAT Costs by Scenario

NAT provided estimates that did not fully consider the cost of access roads, matted roads in wetlands or agricultural fields, and temporary roads for facility construction. Using a \$285,000/mile factor for unmated access roads and a \$1.17 million/mile for matted roads, Trial Staff added these costs to NAT's estimates based on a review of the distance that NAT's proposed projects would be located within wetlands and agricultural areas.

Additionally, NAT has not provided an accurate analysis of the substations and associated interconnection facilities and installation work for its proposals. NAT did not provide any drawings of station layouts and interconnection details. Trial Staff added costs for the type of equipment, materials, and work that would be required for the substations.

NAT has indicated that it plans to build facilities near the Edic and Marcy Substations; however recent experience indicates that this can cause sub-synchronous problems for the Fitzpatrick and Nine Mile Point 1 & 2 nuclear power plants as discovered in the NYPA consideration of constructing series compensation along the Marcy South Lines. Since no interconnection studies have been completed, NAT is unaware of the possible system upgrades that may need to be done as a result of the project. NYPA learned from its project that there were significant relay upgrades necessary at various National

Grid and NYSEG facilities.[29] Such costs have also been factored in by Trial Staff.

Trial Staff's cost estimates with these additions for each NAT scenario are below.

Figure 4: NAT Cost Estimates with DPS Estimates

Scenario #	Scenario Components	NAT Cost Estimate	DPS Cost Estimate
1	ED-FR; NS-LD-PV	$668,750,000	$857,545,283
2	ED-FR; NS-LD-PV Alt 1	$864,750,000	$1,020,716,732
3	ED-FR; NS-LD-PV; sc at FR; connect M-CC to FR	$710,208,000	$911,440,683
4	ED-FR; NS- PV Alt 2; sc at FR; connect M-CC to FR; sc at M; sc at ED	$1,077,291,000	$1,281,224,240
5	ED-FR; NS-KN-PV Alt 2; sc at FR; connect M-CC to FR; ED-PR-KN as proposed by others	$1,033,459,000	$1,224,242,640

NYTOs Scenarios and Impacts

The NYTOs proposed nine scenarios (Scenarios 6-14 above in the "Proposed Scenarios" list in Figure 3). Scenario 6 would connect a new Knickerbocker switching station and Pleasant Valley via Churchtown. Scenario 7 would connect Leeds and Pleasant Valley. Scenario 8 proposed upgrades to the Hurley Avenue Substation. Scenario 9 would connect New Scotland, Leeds and Pleasant Valley. Scenario 10 would connect Oakdale and Fraser, and connect Edic and New Scotland substations, and Knickerbocker and Pleasant Valley stations via Churchtown. Scenario 11 is the same as Scenario 10 but does not include the Oakdale-Fraser circuit. Scenario 12 would connect Edic and New Scotland to Leeds, and reconductor the existing Leeds - Pleasant Valley line. Scenario 13 would connect Edic and New Scotland

[29] See, NYPA, Memorandum: Marcy South Series Compensation Project, p. 1, available at https://www.nypa.gov/Trustees/Agenda_101514/7-Marcy%20South%20Series%20Compensation%20Project%20-%20CEAR%20and%20Contract%20Award.pdf.

and would include upgrades to the Hurley Avenue Substation. Scenario 14 would connect Edic and New Scotland, reconductor New Scotland-Leeds, and add a new circuit between Leeds and Pleasant Valley.

The NYTOs are the only applicant that currently controls the ROW needed for its proposed scenarios and therefore does not require the acquisition of any additional ROW. Environmental impacts would be limited, with the exception of the Oakdale - Fraser ROW, which presently is only partially cleared of forest lands.

Scenarios with reconductoring segments would have less environmental impacts than those requiring large numbers of new structures on existing ROWs. Some structures will likely need replacement or be increased in height along the reconductoring segments, and some new access road construction will be required to accommodate installation of new conductors, wire-pulling and tensioner equipment.

Scenario 6: KN-PV via CH-PV

Scenario 6 includes the replacement of existing lattice tower double circuit 115 kV electric transmission facilities with new 115/345 kV double circuit monopole structures within the existing CH-PV ROW and a portion of the KB-CH ROW. The proposed Knickerbocker to Pleasant Valley (KN-PV) facility will originate at a proposed Knickerbocker Switching Station and terminate at the existing Pleasant Valley Substation. Cross section CT-PV XS-3 shows the proposed removal of two single circuit lattice tower lines and the installation of a new 345 kV/115 kV double circuit monopole. The monopole has davit arms that are different lengths on either side of the pole to carry the different voltage transmission lines. This creates an asymmetrical structure that increases visual contrast since there is a visual imbalance between opposing sides of each structure that limits the visual benefit gained by reducing the number of transmission structures in the ROW. The existing 80-foot lattice structures would be replaced with fewer, but slightly taller structures approximately 85 or 90 feet in height, thereby somewhat increasing their visibility. There should be some potential reduction of impact in agricultural lands, since lattice towers have a larger footprint than monopole structures.

Replacement of two parallel transmission facilities with new monopole double circuit structures may reduce the need to maintain the entire width of the existing ROW and thereby soften the ROW edge with successional vegetation.

The Knickerbocker to Pleasant Valley segment requires some upgrade activity to two existing 115 kV circuits designated by National Grid as circuits #13 and #15 that are interconnected with its Greenbush 115 kV substation. The NYTOs propose to accomplish this by retiring the #13 circuit position at the Greenbush substation and then bussing together the #13 and #15 circuits. Bussing the two conductors involves running short segments of conductor (jumpers) between the two existing circuits at various points along its length so as to increase power transmitting capability.

Scenario 7: LD-PV(R)

Scenario 7 includes reconductoring of two existing 345 kV electric transmission facilities within the LD-PV corridor. The proposal will include replacement of approximately ten percent of existing lattice structures within the ROW and several other structures will be repaired and/or increased in height. New access roads will be constructed in some locations for wire-pulling operations. Lattice structures at the Hudson River crossing will remain and be reconductored.

Scenario 8: HA

NYTOs proposed several modifications to the existing Hurley Avenue Substation, in the Town of Hurley, Ulster County, including the installation of three 575-MW phase angle regulators (PARs), two 135-MVAR switched shunt capacitors and three 345-kV circuit breakers. The proposed modifications would require expanding the substation footprint, but would not require acquisition of additional lands.

The three Phase Angle Regulators (PARs) would be 345 kV at a rating of 575 MVARs and angle of +/- 30 degrees. The smaller units were chosen because NYTOs wanted to ensure that replacement and/or maintenance could be efficiently managed.

The phase shifters will be put in series with line 301, the existing Leeds to Hurley 345 kV line. The substation fence line will be expanded to install the phase shifters, switches and five new circuit breakers.

This project would replace the series capacitor project that the NYISO had identified in the class year study to make the energy from the proposed CPV Valley generating facility deliverable.

Scenario 9: NS-LD(R); LD-PV via CH-PV

Scenario 9 includes the reconductoring of two existing 345 kV steel lattice design electric transmission facilities within the NS-LD corridor including replacement of several existing structures. The improved NS-LD line would cross the Hudson River and structure upgrades or replacement may be required. This scenario also includes replacement of existing double circuit 115 kV electric transmission facilities with new

115/345 kV double circuit structures within the LD-PV corridor. The Leeds to Churchtown (LD-CH) segment of the LD-PV component will cross the Hudson River, parts of which are designated as Scenic Area of Statewide Significance (SASS). The existing Hudson River crossing, southwest of the City of Hudson, is not in a SASS but parts of this segment can be seen from the nearby Catskill-Olana SASS, sub-unit CO-6. The tops of structures northeast of the historic Olana site will be visible from limited locations within CO-6. The existing double circuit 115 kV lattice towers will be replaced with monopole structures of similar height to support double circuit 115 and 345 kV conductors. Increases in visibility or contrast with the existing scene are expected to be minimal due to the background and mid-ground distances from CO-6. Additional considerations of Hudson Valley visual resources are included below in section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations*.

Scenario 10: O-FR; ED-NS; KN-PV via CH-PV

Scenario 10 is the longest of the NYTOs' proposed projects and is also known as the "Enhanced Oct. 2013 Project."

The Oakdale to Fraser (O-FR) component of this scenario would be constructed on existing NYSEG ROW. The proposed 345 kV facility would originate at the Oakdale Substation, located in the Town of Union, Broome County, proceed generally east, and terminate at the Fraser Substation, located in the Town of Delhi, Delaware County. Approximately 1,692 acres of un-cleared forest exists on the O-FR ROW (NYTOs Table 1.1-1). This ROW is wide and varies from 400-700+ feet in width and in most locations there is a single 345 kV transmission line within the ROW. Much of the ROW was not cleared during construction of the existing transmission lines and clearing hundreds of acres of wetlands and upland forests will be required for the proposed 58 mile transmission facility on NYSEG-owned ROW. Some new access roads will be constructed across streams and wetlands for construction at new 345 kV monopole structure locations.

The existing O-FR ROW includes wooden H-frame structures ranging from 65 to 80 feet in height. The addition of the proposed new transmission facility with steel monopole structures 105 feet in height will increase the visual contrasts of the ROW on the surrounding area, as the new structure size and design will contrast with existing facilities on the ROW. The visual analysis for this scenario did not acknowledge one newly designated resource of national significance. The O-F ROW crosses the Susquehanna River, which was recently designated by the National Park Service as a component of the Captain John Smith Chesapeake National Historic Trail.[30]

The Edic to New Scotland (ED-NS) component includes the removal of one set of 220 kV conductors and insulators from each of the two existing 220/345 kV double-circuit monopole structures along the ED-NS ROW. One set of the existing 220 kV conductors and insulators will be replaced with 345 kV conductors and insulators. Additionally, two existing single-circuit 220 kV electric transmission facilities with H-frame structures will be replaced with a single-circuit 345 kV facility primarily using H-frame structures. Tubular steel monopole structures will be used intermittently throughout this 345 kV segment.

A description of the KN-PV via CH-PV component of this scenario is provided in the discussion of Scenario 6.

The replacement of existing structures with new structures proposed by NYTOs provides the opportunity to locate

[30] http://www.nps.gov/cajo/getinvolved/planning.htm

them in less environmentally sensitive areas, thereby mitigating environmental impacts. Replacing four existing transmission facilities with two new transmission facilities between Edic and Pleasant Valley Substations will reduce the number of structures in wetlands and agricultural fields, as shown in Table 1.2-4 (NYTOs, March 2, 2015). NYTOs proposed to reduce the number of structures in federal wetlands from 47 and 44 and from 37 to 32 in New York State-regulated wetlands. Wetlands and agricultural fields less than 700 feet wide may be spanned and some existing structures taken out of agricultural fields and floodplains. Additionally, no new permanent access roads are anticipated in agricultural lands.

Replacing the two existing 220 kV facilities with one 345 kV facility along the 91 mile ED–NS segment ROW will reduce the occupied width of the ROW, therefore potentially reducing total acreage requiring long-term vegetation management. Utilization of the existing stream and wetland crossings along the existing ROW will also lessen the potential impact on aquatic organisms and habitats. Some of these existing crossings will, however, need to be modified to handle the additional weight of concrete trucks and heavy cranes necessary to construct and erect the larger steel monopole structures. New roads to sites without currently existing structures may impact existing ROW habitats.

NYTOs' proposed transmission structures will be taller than those presently on their ROWs. Along the ED–NS ROW the existing wooden H-frame structures are typically 60 and 65 feet tall, while the proposed steel H-frame structures will typically be 86 feet tall, resulting in some degree of increased visibility. Similarly, along the KN–PV ROW, the existing 80 foot steel lattice structures will be replaced with fewer, but slightly taller, 85 or 90 foot monopole structures, thereby increasing their visibility. The ED-NS segment includes a crossing of the Mohawk River-Erie Barge Canal, but significant clearing of forest cover is not expected to occur at this location, due to the use of the existing maintained ROW for this project.

The NYTOs proposes to use a monopole to carry both a 345-kV and a 115-kV transmission line as shown in photographic simulation 1.4-5e and 1.4-5f. The cross section CH-PV XS-3 shows the removal of two lattice towers and the construction of a new 345 kV/115 kV monopole. The monopole has davit arms that are different lengths on either side of the pole to carry the different voltage transmission lines. This creates an asymmetrical structure that increases the visual contrast between the opposing sides of the structure and limits the visual benefit gained by reducing the number of transmission structures in the ROW.

Scenario 11: ED-NS; KN-PV via CH-PV

A description of the ED-NS component of Scenario 11 is provided in the discussion of Scenario 10. A description of the KN-PV via CH-PV component of this scenario is provided in the discussion of Scenario 6.

Scenario 12: ED-NS; NS-LD-PV(R)

A description of the ED-NS component of this scenario is provided in the discussion of Scenarios 7, 9, and 10. The NS-LD-PV(R) component will include reconductoring of two existing 345 kV electric transmission facilities. Additionally, several of the existing steel lattice structures within the ROW will be replaced.

Scenario 13: ED-NS; HA

A description of the ED-NS component of this scenario is provided in the discussion of Scenario 10. A description of NYTOs proposed modifications to the existing Hurley Avenue Substation is provided in the discussion of Scenario 8.

Scenario 14: ED-NS; NS-LD(R); LD-PV via CH-PV

A description of the ED-NS component of this scenario is provided in the discussion of Scenario 10. The NS-LD(R) and LD-PV via CH-PV components of this scenario are described in the discussion of Scenario 9.

NYTOs Project Costs by Scenario

A number of adjustments were made to the NYTOs estimates: AFUDC estimates were removed and the resulting figures were multiplied by 1.03 to bring them up to 2015 dollars. Additionally, Trial Staff removed the NYTO's contingency and replaced it with a standard 30% figure, removed the applicant's roads and matting costs and replaced them with a standard measure common to all applicants in same rights-of-way and added the Global Additions described above. The cost estimates as determined by Trial Staff for the NYTOs projects are below.

Figure 5: NYTOs Cost Estimates with DPS Estimates

Scenario #	Scenario Components	NYTOs Cost Estimate	DPS Cost Estimate
6	KN-PV	$616,973,842	$631,056,714
7	LD-PV(R)	$359,331,390	$361,121,527
8	HA	$242,082,849	$226,353,075
9	NS-LD(R); LD-PV	$635,172,770	$630,947,291
10	O-FR; ED-NS; KN-PV	$1,404,610,880	$1,439,170,175
11	ED-NS; KN-PV	$1,194,071,098	$1,188,796,308
12	ED-NS; NS-LD-PV(R)	$1,104,641,757	$1,090,171,224
13	ED-NS; HA	$848,286,806	$822,562,139
14	ED-NS; NS-LD(R); LD-PV	$1,228,635,727	$1,218,317,655

NextEra Scenarios and Impacts

NextEra proposed five scenarios (15-19b) in Cases 13-T-0455 and 13-T-0456. Those proposed in Case 13-T-0455 would build 345-kV transmission lines between Edic and Pleasant Valley (Scenario 15) Marcy to Pleasant Valley (Scenarios 16 and 17) and Greenbush to Pleasant Valley (Scenario 19a). Scenario 19b includes only a segment between Oakdale and Fraser. In its Interim Report, Trial Staff included the Oakdale-Fraser segment in all NextEra scenarios. In comments provided at subsequent Technical Conferences and in written correspondence, NextEra stated that it did not intend for Oakdale-Fraser to be part of all of its proposals. Upon further review, Trial Staff has removed this segment from its analysis and has analyzed it as its own separate scenario, 19b.

Scenario 15: Thruway ED-LD-PV

Scenario 15 proposes a line from Edic-Leeds-Pleasant Valley. This scenario includes a 345-kV transmission line alongside the Thruway which will require acquisition of at least a 35 foot-wide corridor of additional ROW area adjacent to the

Thruway. Each of the substations will require additional equipment. The proposed spun concrete transmission towers are shown in photo simulations of the existing Thruway ROW (NextEra Case 13-T-0455 Part A Application, Volume V, and Figure T-5-13).

A visual analysis identified 747 aesthetic resources of state significance within the Thruway viewshed. Furthermore, 337 aesthetic resources may be affected, including 11 Forest Preserve parcels.

In general, travelers on the Thruway will have a clear view of the lower portions or more of most transmission towers, a view of multiple towers along the highway in flat straight stretches of the road, and a near-continuous view of new towers along some 150 plus miles of the Thruway.

A Visual Resource Assessment Report (VRAR) (March 2, 2015, Case 13-T-0455, NextEra Part A Supplement) was completed for the proposed transmission line along the Thruway. NAT also proposed use of the Thruway corridor in Scenario 2 and the following evaluation is applicable to that proposal. The NextEra VRAR included two photographic simulations of the travelers' view of the proposed 97 foot tall structure facilities along the Thruway, including the travel plazas near Little Falls and New Baltimore. A Thruway traveler at either of these locations will have a view of nine or more transmission towers and associated conductors. The NAT visual assessment included a photographic simulation of the New Baltimore Rest Area (NextEra Figure D-2 KOP A1-1). In general, travelers on the Thruway will have a clear view of the lower portions or more of most transmission towers, a view of multiple towers along the highway in flat straight stretches, and a near-continuous view of new transmission towers and conductors along some 150+ miles of the Thruway. The simulations demonstrate the views along the Thruway will be changed from a vista composed of an interstate highway and variable visual settings to a vista that will be composed of interstate highway, transmission line and less variable visual settings. The prominence of the transmission line when set against rural or undeveloped areas will change the visual character of most of the entire 150+ mile long corridor. Thruway travelers will have a continuous and repetitious view of tall transmission towers that will diminish the quality of the visual setting. The construction of a transmission line along the Thruway will introduce a visual element that has strong contrast compared to the surroundings. The introduction of the rigid vertical forms creates a sharp edge, in contrast to gradual natural rolling land forms that blend with an irregular pattern of open lands, vegetation, and forest land on a variety of land forms. The color of facilities can be selected to reduce contrast, however due to seasonal conditions and background colors there will be potential for strong color contrast in various locations.[31]

The proposed overhead transmission facilities would be built in scenic areas of the Thruway and be out of scale with the (relatively) low profile highway. Visual exposure would be high, since the Thruway carries high volumes of traffic. The Average Daily Traffic (ADT) from Rome to Schenectady (I-90) varies from 15,179 to over 26,832 in 2012.[32] In the Albany to Schenectady Thruway segment the ADT volume is 40,988 to 73,859, including both commuter traffic between the cities and longer distance travelers. Immediately south of Albany the Thruway (I-

[31] United States Department of the Interior, 2013 Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM Administered Lands Bureau of Land Management. Cheyenne, Wyoming, p. 342.

[32] NYS DOT Traffic Data Viewer, 2012 Counts, available at http://gis3.dot.ny.gov./html5review/?viewr=tdv.

87) ADT is 37,120. ADT is based on a continuous count of vehicles on the highway segment. The ADT is a 24 hour vehicle count that includes data collected at night; therefore the number of daytime viewers is less than the full ADT. Typically, 75 percent of Thruway traffic occurs during the daylight hours. The number of viewers in the Schenectady to Albany segment of the Thruway during daylight hours was 30,741 to 55,394 in the most recent traffic count report.

Large numbers of drivers and passengers will have a clear view to the individual towers and will see numerous towers along the vista that makes up the visual setting of the Thruway. The Thruway's existing vista of a mix of mowed ROW with forested areas will change to one that is continuous area of mowed ROW with clear views of each tower 50-100 feet from the travel lanes, and generally uninterrupted views of towers along the corridor. Loss of forest cover will change the visual landscape character from rural to a setting that is typical of ROWs in more developed areas.

Aesthetic resources of statewide significance include sites and land uses of interest to or are identified by regulatory programs of New York State agencies. Some of the affected aesthetic resources of state significance within three miles of the proposed ROW include 11 state parks or Historic Sites, seven Forest Preserve parcels, five SASS and five state nature reserves or historic preserves. Hudson River coastal area resource considerations including SASS and Local Waterfront Revitalization Program (LWRP) are included below in the section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations*.

Trial Staff performed an Electromagnetic Field (EMF) study and an Electrostatic Field study of the NextEra design, based on reported structure heights and Trial Staff's assumed clearances for the lines and bundle configurations, as NextEra did not provide this information. Based upon the NYS DOT Utility Accommodation Policy, the transmission line would need to be located near the outer edge of the Thruway ROW, and calculations that indicate NextEra will need a 100 foot wide ROW or 50 feet on either side of the center line, Trial Staff concludes that one side of the facility ROW would need to be outside of Thruway ROW on private property, requiring the acquisition of new ROW by NextEra (or by NAT, for Scenario 2) to accommodate the facility and necessary clearances.

The facility would not be able to be in close proximity to any Thruway Service Areas. Close proximity to Service Areas is proposed, as represented by NextEra (and NAT) in the simulations of proposed facilities (See, Case 13-T-0454, Figure D-2 KOP A1-1, and Case 13-T-0455 Part A Application, Volume V January, Figure T-5-13). Trial Staff concludes that such close proximity would result in induced voltages in vehicles and large trucks parked near the overhead AC lines. This could result in drivers experiencing static electric shocks when they returned to their vehicles. Tanker vehicles containing large volumes of volatile fluids travel on the Thruway, creating a higher risk from static charges in some situations.

Audible noise calculations from transmission facility operation show that the line is relatively quiet as compared to Thruway traffic noise. Given the noise from flow of traffic, temporary construction noise from installation of a transmission facility at this location is not expected to significantly increase the daytime average noise levels at residences located near the Thruway ROW as it would in a rural environment with no interstate highways in the vicinity.

NextEra has estimated that there are 750 residences within 1- to 250- feet of the proposed ROW (Table 2.4 - Residences within the Marcy/Edic to Pleasant Valley Project Area, March 2, 2015). Additionally there are 2,584 residences within 500 feet of the ROW, demonstrating that the Thruway ROW proposal has the largest number of residences near the facility compared to all other scenarios in this proceeding.

Scenario 16: M-PR-PR-R, GB-KN-CH-PV, Marcy Southern 1

Marcy Southern 1 is a project in two segments: Marcy to Princetown to Rotterdam (M-PR-R), and Greenbush to Pleasant Valley (GB-PV).

The proposed Marcy Southern 1 route would cross the Mohawk River and Erie Barge Canalway National Heritage Corridor. All construction would occur within existing ROW; based on review of aerial photography most of the ROW is cleared of large trees. NextEra proposes to decommission one or two of the National Grid 220 kV transmission lines from Marcy Substation to the proposed Princetown Substation and replace them with a single 345 kV facility. Throughout an approximately 50 mile segment, both of the existing 70 foot tall wood H-Frame structures would be replaced by a single 97 foot tall spun concrete monopoles, thus increasing the average height of structures by 28 feet. A corrected Projected Visualizations that shows the removal of the two H- Frames and replacement with the single 97 foot spun concrete pole was submitted (NextEra letter DLA Piper August 21,2015 Exhibit 3 VP 1-3). As noted above, the visual assessment by NextEra evaluated the visibility of the proposed transmission towers, without showing the visibility of the current transmission facilities in the ROW. In order to assess net increase or decrease in visibility of the ROW, locations and heights of existing transmission towers are required. NextEra's viewshed analysis is sufficient for the current evaluation.

NextEra proposes to build the Princetown Substation with two 600 MVA 345/220 kV autotransformers. The scenario also includes construction of a 115 kV transmission facility from the existing Greenbush Substation to a proposed Knickerbocker Switchyard. From the proposed Knickerbocker Switchyard to Pleasant Valley Substation, existing double-circuit steel lattice 115 kV structures would be replaced by a 345 kV transmission facility using spun concrete monopoles. The visual analysis (Marcy to Pleasant Valley) identified 381 aesthetic resource of state significance within three miles of the ROW, and potentially 99 that may be affected, including five State Parks or Historic Sites, one SASS, nine Forest Preserve parcels and three State Nature or Historic preserves.

NYTOs Scenario 11 and NextEra Scenario 16 are competing proposals that would be built on the same ROW between the Edic-Marcy area and Princetown. The differences in the estimates of the land cover, land use and resource information between NextEra and NYTOs, as reported in Table 1, is due to the difference in the reported width of the affected area.

NextEra and NYTOs have submitted visual analysis that includes visibility mapping and visual simulations. NextEra visual simulation VP-3 (Darrow Road near State Route 162) is east of NYTOs visual simulation SO-1 and both appear to be in the Town of Root, Montgomery County. The landscape setting is open farmland with mixed forest. The NextEra visual simulation shows the proposed 97 ft. monopole, while NYTOs simulation of Scenario 11 shows a new steel H-Frame (80-85 ft.) with removal of the existing wood 70 ft. H-Frame structure. The height of the NextEra monopole may be noticeable when there is trees near-by as seen in VP-3 simulation. The NYTOs photographic simulations(SO-1) shows that the difference between the heights of the 80-85 ft. steel H-frames and nearby trees is less noticeable than compared to the differences seen between the trees and taller monopoles proposed by NextEra. When monopoles are viewed at distance since it is a single structure it may be less visually significant and the H-frames due to lower heights maybe screened by intervening vegetation or topography. Visually the monopole or H- frame maybe acceptable and further evaluation will be completed during the next portion of the process.

NextEra photo simulation VP-4 and NYTOs S-19B are both in the Guilderland-New Scotland area of Albany County. The photographic simulation VP-4 shows the replacement of the large, tall steel H-Frame structures with two spun-concrete monopoles and conductors held in a delta formation. This change adds conductors, insulators and larger transmission structures. There is a noticeable increase in the numbers and types of structure elements in the vista. The NYTOs' photographic simulation S19b is a side-on view of the ROW that is difficult to compare to the NextEra down-the-line axial view. The NYTOs project leaves the large tall steel H-frame in place and adds an H-frame to carry the new 345 kV transmission line. This commits space in the ROW to a new transmission line but visually reduces the number of structural elements in the visual setting.

Scenario 17: M-PR, PR-R, PR-NS-KN, GB-KN, KN-CH-PV Marcy Southern Route 2

The Marcy Southern Route 2 New Scotland to Pleasant Valley (Marcy Southern 2 NS-PV) component will include a Hudson River crossing by either rebuilding the existing National Grid overhead crossing, installing by a bridge attachment, or by underground installation via HDD. The visual analysis of

Scenario 17 identified 476 aesthetic resources of statewide significance within three miles of the ROW, 183 of which may be affected, including 17 State Parks or Historic Sites, one SASS, nine Forest Preserve parcels and five State Nature or Historic preserves. Coastal area resource considerations including SASS and LWRP are included below in section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations*.

The arrangement of proposed structures from Marcy to New Scotland and Greenbush to Pleasant Valley is the same as that proposed for those segments of the Marcy Southern Route 1 component of Scenario 16. However, between Princetown and Knickerbocker, Scenario 17 includes removal of the metal H-frame structures that support the National Grid 345-kV (originally designed for 765 kV transmission) transmission facility from Princetown to Knickerbocker. Scenario 16 and 17 are proposed for the same ROW as NYTO scenarios 10, 11, 12, 13, and 14.Table 1 provides additional descriptions of Scenario 17 and the resources located in the ROWs.

Scenario 18: M-OH with GB-KN-CH-PV Marcy North

Scenario 18 includes two components: Marcy to Orchard Hill (M-OH) 345 kV facility via Northern Route, and Greenbush (115 kV) to Knickerbocker to Pleasant Valley (GB-KN-PV) 345 kV facility. A 97 ft. monopole will be is proposed for the M-OH segment and a 105-ft. monopole is proposed for the GB-KN-PV segment.

The proposed M-OH component is proposed as a 110-foot wide ROW expansion adjacent to existing National Grid ROW that contains the Edic-New Scotland (M-NS) 345-kV line, which is built on existing 90 foot lattice or 90 foot metal H-frame structures. The existing M-NS ROW includes a 345-kV line built on 175 foot tall green metal H-frame, designed to 765 kV, and the Rotterdam-New Scotland 115-kV line or other 115-kV transmission facilities built on 70-90 foot lattice or wood H-frames. This scenario will include construction of a new substation located on Orchard Hill Road in the Town of New Scotland, Albany County, and a connection to the existing New Scotland Substation. The M-OH component, which is approximately 84 miles in length, would occupy 1,106 acres of land. The proposed line would include new overhead crossings of the Mohawk River and Erie Canalway and clearing of forest vegetation near the canal crossing, conflicting with provisions of the Canalway Preservation and Management Plan, and incrementally affecting viewsheds within the Erie Canalway National Heritage Corridor. Additionally, visual analysis of the facility location identified 139 aesthetic resource of state significance within three miles of the ROW, which may be affected, including two State Parks or Historic sites and four Forest Preserve parcels.

The GB-KN-PV component of Scenario 18 would be a 115-kV transmission facility originating at the Greenbush Substation, in the Town of East Greenbush, Rensselaer County, proceeding approximately eight miles south to a proposed Knickerbocker substation, in the Town of Schodack, where the facility becomes a 345 kV facility proceeding south and terminating in Dutchess County at the Pleasant Valley Substation. This component would also include a connection to the existing Churchtown Substation in Claverack, Columbia County. The Knickerbocker-Churchtown segment traverses the Columbia-Greene North SASS area, as described below in section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations.*

Scenario 19A: GB-KN-CH-PV

Scenario 19a includes an electric transmission facility originating at the Greenbush Substation and terminating at the Pleasant Valley Substation. This component will include two additional connections at the proposed Knickerbocker Switchyard and the existing Churchtown Substation. The Greenbush to Knickerbocker to Churchtown to Pleasant Valley (GB-KN-CH-PV) components will be constructed within existing ROW.

The GB-KN-CH-PV component will include 7.8+ miles of a 115 kV transmission line from the Greenbush Substation to a ring bus at the proposed 345-kV Knickerbocker Switchyard. From Knickerbocker, two 115/345 kV double circuits will be constructed south to the Churchtown Substation and a single 115/345 kV double circuit facility will proceed further south and terminate at the Pleasant Valley Substation. The KN-CH-PV component will have potential for significant visual impacts. The visual analysis of this component identified 273 aesthetic resources of state significance within three miles of the ROW, including 16 State parks or State Historic Sites. The line will pass through the Columbia-Greene North SASS area on existing ROW, as described below in section *Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations*.

Attached Table 1 provides additional description of this scenario and summary of the environmental components.

Scenario 19B: O-F

This scenario will connect the Oakdale and Fraser substations (as proposed in Part A filing in Case 13-T-0456) with a new 345-kV electric transmission facility originating at the NYSEG Oakdale Substation in Broome County, proceeding generally east, and terminating at the NYSEG Fraser Substation in Delaware County. The ROW is in a rural area with 33 possible residential structures within 250 feet of the ROW. The visual analysis identified 150 aesthetic resource of state significance within three miles of the ROW, which may be affected by the project. The proposed O-FR component includes installation of new 97- to 105-foot tall spun concrete monopoles at various locations within the cross section of the existing ROW that is currently occupied by various utilities (NYSEG, NYPA, and others). The existing utility ROW varies in width from 400 to 700+ feet. The proposed facilities will include overhead crossings of the Tioughnioga, Chenango, and Susquehanna Rivers. The visual analysis did not acknowledge one newly designated resource of national significance. This ROW crosses the Susquehannah River, which was recently designated by the National Park Service as a component of the Captain John Smith Chesapeake National Historic Trail.[33]

Next Era's O-FR 345-kV transmission line is proposed for the same ROW as the NYTOs O-FR project (Scenario 10) discussed above. Next Era's O-FR facility is proposed as 57.03 miles, while NYTOs is proposed as 57.7 miles.

Scenario 19C: KN-PV

This scenario is identical to Scenario 19a, with the exception of the Greenbush-Pleasant Valley segment, which is not included in this scenario. This change would make 19a identical to the NYTOs Scenario 6, which includes upgrades at the Greenbush Substation and is the segment recommended for NYISO action by Trial Staff.

[33] http://www.nps.gov/cajo/getinvolved/planning.htm

NextEra Costs by Scenario

With respect to NextEra's cost estimates, Trial Staff again included the same Global Additions and roads/matting costs used for other applicants. Additionally, NextEra's included interconnection costs and replaced them with standard costs applicable to all Applicants.

Figure 6: NextEra Cost Estimates with DPS Estimates

Scenario #	Scenario Components	NextEra Cost Estimate	DPS Cost Estimate
15	Thruway ED-LD-PV	$735,117,633	$864,836,574
16	Marcy Southern 1 (M-PR;GB-KN-CH-PV)	$701,699,107	$856,691,318
17	Marcy Southern 2 (M-PR;PR-R; NS-KN-CH-PV)	$842,722,379	$1,038,632,316
18	Marcy Northern (M-OH; GB-KN; CH-PV)	$657,227,913	$822,448,288
19a	GB-KN-CH-PV	$386,137,312	$460,855,417
19b	O-FR	$386,137,312	$460,855,417

Boundless Scenarios and Impacts

Boundless has proposed two scenarios in this proceeding. Scenario 20 includes the following components:

1. Reconductoring of the existing 345 kV line from the proposed CPV Valley Tap to the Rock Tavern Substation;
2. Reconductoring from the Leeds Substation to the Hurley Avenue Substation;
3. Installation of two sets of 345 kV underground conductors from the Roseton Substation to the East Fishkill Substation;
4. 40 percent series compensation equipment to be placed along the Leeds-Hurley Avenue-Roseton 345 kV lines; and
5. Installation of a 0.5 percent series reactor facility on the New Scotland to Leeds circuits.
6. Reconductoring of the existing 345-kV circuits from the Athens Generating Substation to Leeds Substation and reconductoring of the existing 345 kV circuits from the Leeds Substation to the Pleasant Valley Substation.

Boundless' Scenario 21 includes all above listed components except number six, the reconductoring of Leeds-Pleasant Valley. It should be noted that Trial Staff has assumed that the section titled "Athens to Leeds" will not be included as part of Scenario 21. "Athens to Leeds" is limited to the short length of the interconnection lines between the Athens generating facility and the Leeds Substation (approximately 3000 feet). This particular section is included as a separate item in some Application sections and combined as part of the "Leeds to Pleasant Valley" segment in other areas of Boundless' Application. For clarification, the "Athens to Leeds" and "Leeds to Pleasant Valley" sections will be referred to as separate segments in this discussion.

For its reconductoring proposals, Boundless would use aluminum conductor composite core (ACCC) or aluminum conductor composite reinforced (ACCR) cables to replace the existing aluminum conductor steel reinforced (AACSR) cables. The cables proposed for use by Boundless reportedly increase conductivity and capacity. According to Boundless, helicopters can be used during removal of old and stringing of new conductors. Trial Staff counters this notion, and expects that most of these activities will be performed using traditional methods utilizing ground equipment. The reconductoring process is described previously in this document. Some minor aspects of the reconductoring may be accomplished with the aid of helicopters; however, Boundless has not provided documentation supporting such use.

The specific composite cable proposed by Boundless requires unique splicing and pulling, as the cable itself is delicate and may require more equipment and land area for setup, handling and wire-stringing and pulling, than described previously in this document. Structural feasibility studies will need to be performed on towers prior to Trial Staff's endorsing of the proposed reconductoring activities.

Boundless has provided all environmental data necessary for assessment of the projects. However, it should be noted that Boundless provided distances for residence proximities from the edge of the ROW; whereas other Applicants submitted distances in relation to proposed transmission facilities, as noted on page 7 of the document titled "Order Establishing Modified Procedures for Comparative Evaluation," dated December 16, 2014. Therefore, the numbers listed in Table 1 may not accurately reflect residential distances from the proposed transmission facilities.

Scenario 20: Athens Generating–LD–PV(R); LD–HA(R); CPV–RT(R); RS–EF

Reconductoring is proposed from the Athens Generating Substation to the Leeds Substation, the Leeds Substation to the Pleasant Valley Substation, the Leeds Substation to the Hurley Substation, and from the CPV Valley Tap line to the Rock Tavern Substation. The proposed conductors will be ACCC or similar cables, and according to the Application, will utilize existing structures in the ROW. Certain structures, according to Boundless, will require upgrading of cross bracing units. Boundless also notes that larger sized conductors could be installed if larger capacity is desired. Replacement may be necessary for some towers along the proposed projects. From an environmental standpoint, it would not be practical to install new conductors on aging infrastructure that would require another sequence of more extensive environmental impacts associated with a more significant construction effort in the near future. Consideration should be given to replacement of the infrastructure prior to and during reconductoring activities.

According to Boundless, aerial reconductoring via helicopter will be done on existing transmission structures, and therefore, no ground disturbance is anticipated to wetlands and/or waterbodies. However, as previously noted, Trial Staff anticipates that most aspects of the helicopter reconductoring proposal appears to be infeasible. Consequently, some minor environmental impacts should be expected to wetlands and water bodies during ground activities. Data provided in Table 1 indicates wetlands/waterbodies crossed along the entire existing ROW. The number of wetlands and waterbodies noted will not necessarily be impacted during reconductoring activities, as it is unknown if structures exist directly within these features, or if access roads will be used to cross through these features.

Boundless has proposed to install two underground 345 kV circuits from the Roseton Substation to the East Fishkill Substation, a distance of approximately eight miles. Approximately one mile of this route will be installed using the HDD method to cross the Hudson River. The remaining cable route is proposed to be installed via traditional open cut trenching; minor impacts can be expected from these activities. Impacts to be expected from the HDD activities include potential drilling fluid leaks or "frac-outs" and clearing for staging areas for construction equipment and entrance and exit pits. Additionally, noise to the surrounding community can be expected during HDD operations. Impacts expected during open cutting include traffic disruptions, erosion disturbances, and noise to residences and businesses during trenching and backfilling.

The proposed reconductoring from Leeds to Pleasant Valley will traverse the Hudson River from the Village of Athens, Greene County, to the Town of Greenport, Columbia County; crossing the designated coastal zone and Athens Village LWRP area of Greene County. Resource and environmental aspects of reconductoring the Leeds-Pleasant Valley line is generally addressed above in discussion of Scenario 7.

Scenario 21: LD–HA(R); CPV–RT(R); RS–EF

Scenario 21 includes the following three project components: LD-HA reconductoring, CPV-RT reconductoring, and the RS-EF 345 kV underground segment. A description and summary of environmental factors for each of these components are included in the discussion of Scenario 20.

Boundless Costs by Scenario

Trial Staff added additional Legal and Insurance costs to Boundless' estimates along with a 30% contingency, insulator assembly costs, engineering costs, and costs for upgrades at the Roseton Terminal. Trial Staff's cost estimates for Boundless' proposals are below.

Figure 7: Boundless Cost Estimates with DPS Estimates

Scenario #	Scenario Components	Boundless Cost Estimate	DPS Cost Estimate
20	LD-HA(R); Athens Generating-LD-PV(R); CPV-RT(R); sc LD-HA-RS; sr NS-LD	$736,715,587	$917,905,890
21	LD-HA(R); CPV-RT(R); sc LD-HA-RS; sr NS-LD	$509,526,682	$671,472,003

Generation Alternative

In order to determine the full extent of the benefits and costs of the various transmission solutions proposed by the Applicants, Trial Staff, in concert with the NYISO and Brattle, developed two additional scenarios, beyond the transmission scenarios outlined above. The first is a generation alternative. The elements of this scenario were brought together using the NYISO's CARIS methodology, which resulted in the selection of a 1,320-MW combined cycle gas turbine facility generically located in Zone G, i.e. an area where the plant could be dispatched to meet the needs in SENY. This generic facility is assumed to operate at a 7,000 Btu/kWh heat rate and $7/MWh VOM. The costs for this unit were established using the NYISO's 2013 Demand Curve Reset, which assumes a 311-MW combined cycle plant in Zone G, would cost $501 million or $1,573 per kW. Using this as a base, the generic 1,320-MW unit's costs would be $2.07 billion in nominal dollars, including $69 million for a transmission interconnection, and $3.33 billion in Net Present Value (NPV) over a 25-year assumed economic life. Further details regarding the assumptions in this scenario can be found in the Brattle report, attached as Appendix 1.

REV Alternative

Trial Staff (with NYISO and Brattle) developed a scenario based on the rollout of the Commission's Reforming the Energy Vision (REV) goals. This scenario uses the "Lower" scenario in the Generic Environmental Impact Statement (GEIS) in Case 14-M-0094 and assumes demand reductions in SENY of 1,200 MW. These resources were assumed to be distributed between Zones G-J based on current penetration levels and potential for growth (see Appendix 1, Slides 9). REV resources are assumed to be phased in at a rate of 20 percent per year over five years, at a total cost of approximately $2.63 billion divided 60%/40% percent between utility programs and ratepayers. The GEIS cost estimates assume a 20 percent increase in annual spending on energy efficiency for the first five years and increasing effectiveness of future spending on energy efficiency by 10-20 percent. The costs presented here then are somewhat uncertain, but illustrative of the costs associated with REV resources compared with transmission scenarios.The REV resources assumed to be installed or utilized are summarized in the table below.

Figure 8: REV Resource Summary

Resource	Capacity	Energy	Costs	Economic Life
Energy Efficiency	838 MW	5,497 GWh	$2,100/kW	12 years
Customer Sited Renewable	73 MW	98 GWh	$8,600/kW	25 years
Demand Response	89 MW	N/A	$600/kW	10 years
Combined Heat and Power	28 MW	195 GWh	3,800/kW	20 years
Rate Structures	117 MW	N/A	N/A	15 years
Grid Integrated Vehicles	15 MW	-2 GWh	$600/kW	10 years
Energy Storage	40 MW	-5 GWh	$1,500/kW	15 years
Total	1,200 MW	5,783 GWh	$2,200/kW avg	10-25 years

Undoubtedly, REV will be a driving force transforming New York's energy delivery system. The upgrades to the AC transmission system, however, will provide benefits not readily achievable by REV and better addressed through the transmission investments recommended by Staff. Among these is enabling renewable resources (wind, incremental hydro) located in upstate New York that will be needed to drive down air emissions and assist in achieving the State Energy Plan goals. Reduced transmission constraints and congestion allow for access to upstate generation that is currently bottled and improved system efficiencies. Further, access to this generation helps to mitigate the loss of existing, aging generation resources downstate that might result from retirements or equipment failures. Last, while REV can provide operational flexibility at the distribution system level, the upgraded AC transmission system will provide system operators increased operational flexibility to respond to unforeseen outages resulting from storms, from the need to make emergency repairs or rebuild other portions of the AC transmission system, and from the ability to better withstand unexpected increased peak demands resulting from unusually warm or cold weather conditions.

ANALYSIS

Description of Process Undertaken by Trial Staff and NYISO/Brattle

Trial Staff analyzed the scenarios filed by the Applicants in conjunction with the NYISO and Brattle. As will be explained in more detail in the sections that follow, Trial Staff completed an environmental analysis of the various scenarios. The NYISO provided Trial Staff and Brattle with Power Flow information for all scenarios, based on the project characteristics contained in the Applicants' respective Applications. At the direction of the NYISO and Trial Staff, Brattle conducted MAPS analyses on a number of change cases, including Trial Staff and NYISO selected transmission change cases, a generation change case, and a REV change case. Trial Staff analyzed both the Power Flow and MAPS results, as well as corresponding Benefit/Cost ratios for the various scenarios selected and the results of that analysis are detailed below.

This analysis was first completed prior to the issuance of Trial Staff's Interim Report, however, shortly before that issuance, CPV Valley announced that it had received financing to build a generating station. This necessitated a further evaluation of the Power Flow, MAPS and Benefit/Cost results. The first set of Power Flow results are contained in the Interim Report, both sets of Brattle's analysis are attached as Appendix 1.

With this in mind, in short, the results of these various analyses indicate that generally, with CPV Valley included in the base case, UPNY/SENY Normal Transfer Capability (NTC) increased from 352 MW to 1136 MW, although some projects still resulted in actual decreases; impacts on the Central East NTC varied from an increase of 375 MW to a decrease of 25 MW; numerous projects resulted in positive Benefit/Cost ratios; and the projects proposed presented a wide range of potential environmental impacts. Trial Staff's final recommendation, outlined below and contained in the Motion accompanying this report, was based on a holistic review of all factors.

Public Policy Need

The Commission recognized that upgrades to the Central East and UPNY/SENY electrical interfaces of the electric transmission system could produce various benefits for New York, including: 1) enhancing system reliability, flexibility, and efficiency; 2) reducing environmental and health impacts through reductions in less efficient electric generation; 3) increasing diversity in supply, including additional renewable resources; 4) promoting job growth and the development of new efficient generation resources Upstate; and, 5) mitigating reliability problems that may arise with expected generator retirements.

The Commission has not yet deemed the scenarios proposed in this case to meet its public policy goals, however, based on the ability of the project recommended by Trial Staff to provide these benefits, the Commission should find that there is a Public Policy Need in adopting Trial Staff's Motion. These benefits and others are individually discussed in more detail below:

Reduced Production Costs Resulting from Congestion Relief

The Commission requested the project proponents to address the congestion on the UPNY/SENY interface. This congestion has historically resulted in higher electric bills for Downstate New York ratepayers, especially those in the New York City area. As background information, in the absence of any transmission constraints, an increase in load will be served by the lowest cost available generator(s) that can provide additional energy. Congestion occurs when a transmission constraint prevents less expensive upstream generation from serving an increase in load downstream of that constraint. Consequently, more expensive downstream generation needs to be used to serve the additional downstream load. The difference in cost resulting from serving load with more expensive generation versus less expensive generation is referred to as the cost of congestion. In this regard, the NYISO has estimated the total cost of congestion in New York State. For the top two transmission constraints in New York (Central-East and New Scotland-Pleasant Valley), the average annual cost of congestion for 2005 through 2014 amounted to $262 million, while this cost was forecast to be $332 million and $362 million in 2019 and 2024 respectively.[34] These values show the total congestion savings that can be attained if these transmission constraints were to be completely eliminated.

For an individual congestion relief project proposal, the potential congestion savings amount to the estimated changes in production costs (generator fuel burn costs plus generator variable operating and maintenance costs) with versus without that particular project in service (i.e., the net change in production costs that could result from that specific project). In the process of serving load from less expensive generation due to a new project, additional production cost savings may also accrue from reduced electric system losses and/or emission allowances produced.

[34] NYISO hourly DAM limiting constraint data (shadow prices) for 2005-2014. Line and interface limits, and forecasted congestion rents: NYISO annual congestion data summaries for 2005-2014 (TCC Fund annual totals).

Improved Preparedness for Impacts of Generator Retirements

As has been recently observed across the State, there are many generating units which are fast approaching or already exceeding their useful life expectancies. Over the past 3 years alone, the NYPSC has received retirement/mothball notices for over 1,390 MW. Generator retirement risk exists in both Upstate and Downstate New York which could be detrimental to both reliability and market competition. However, retirements in Southeast NY would pose a more pressing reliability risk in terms of resource adequacy and locational capacity requirements. Further loss of generation resources in SENY will only exacerbate the existing congestion issues and further stress the transmission system in managing power flows to transport more energy from upstate New York to reach downstate load centers. As noted by the NYISO, nearly 12,000 MW, over 60%, of generation in SENY will be over 50 years old by 2024.[35]

More specifically, the potential closure of the Indian Point Energy Center continues to pose risks to system reliability and resource adequacy. Based on the findings in the NYISO's 2014 Comprehensive Reliability Plan, there are approximately 1,500 MW of surplus generation in downstate in 2016. If Indian Point Energy Center were to become unavailable in 2016, the loss of 2,000 MW capacity in SENY would immediately result in reliability violations.[36] The CRP further indicates that the capacity margin in SENY continually shrinks by approximately 200 MW each year, leading to a margin of only 10 MW by the year 2024. To help address the threat imposed by a an Indian Point shutdown, the Commission accepted implementation of

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[35] NYISO Comments on Why a Robust New York Transmission Grid is Required; Case No. 14-E-0454, June 4, 2015

[36] NYISO 2014 Comprehensive Reliability Plan – Indian Point Sensitivity

two elements in Case 12-E-0503: (a)three Transmission Owner Transmission Solutions (TOTS) projects; and (b) a 125 MW Revised Energy Efficiency/Demand Reduction/Combined Heat and Power (EE/DR/CHP)Program in the Con Edison service territory.

Enhanced Reliability

The AC electric transmission system is the backbone of a reliable transmission system. The AC system promotes reliability through its ability and flexibility to respond to emergencies on the system. As indicated in the 2014 Comprehensive System Plan by the NYISO, the New York bulk power system is reliable today, and under existing conditions, is expected to remain reliable for the remainder of the NYISO's ten year planning horizon. However, upgrading bulk transmission facilities can result in additional reliability benefits. The NYISO's reliability planning analysis is conducted to meet a minimum level of technical reliability standards. Upgrading the bulk transmission infrastructure in the state better positions the system to mitigate any potential threats to reliability. When the NYISO conducts its reliability planning analysis it looks at scenarios and sensitivities where reliability concerns may exist. Being able to position the system to meet a wide range of potential future scenarios is important to maintaining reliability. Under a scenario where Downstate generation retires, increased transmission capability from surplus upstate resources into downstate load centers would be vital.

Reduced Costs of Meeting the Renewable Portfolio Standard (RPS)

Another benefit of transmission solutions is the reduced costs of meeting the State's Renewable Portfolio Standard (RPS). Potential cost reductions can be estimated for achieving future wind capacity goals through the addition of the proposed transmission solutions. Transmission solutions would provide greater access to wind resources located in Upstate New York and provide higher revenues to those resources. These benefits materialize as increases in LBMP's in zones where new wind capacity is located or expected to be built. New York's current RPS goal is to obtain 30% of its electricity from renewable resources by the year 2015. This goal has been further expanded by the NY State Energy Plan, which provides the goal of meeting 50% of our electricity needs from renewable by 2030. Meeting these goals will require significant additions of renewable resources being added to the system in the near future. Enabling access to these new resources is key to the success of the program. Based on the Brattle Report, the cost of meeting a specific MWh renewable policy goal is estimated as the additional Renewable Energy Credit (REC) payments required to attract new wind generation. REC cost savings may occur due to higher LBMPs and/or reductions in curtailments. Results of modeling analysis show that added transmission capacity increases the UPNY LBMP, which has the effect of REC cost savings, thereby reducing the cost of meeting the RPS goals. These quantifiable benefits are presented for the proposed transmission projects.

Reduced Capacity Resource Costs

In addition to purchasing energy to serve daily needs, loads in New York are obligated to purchase capacity on a longer term basis to insure adequate supplies will be available to help maintain reliability. In addition to congestion typically denoting that lower cost energy cannot currently be accessed, transmission constraints can result in higher capacity costs downstream of the constraint. Thus, relieving transmission constraints can also produce capacity cost savings. These savings can result from reduced Installed Reserve Margin (IRM) Requirements translating into potential capacity savings for all loads in New York. Additionally, these savings can take the form of reduced Locational Capacity Requirements (LCR) which in turn could reduce capacity costs for designated Capacity Zones in New York.

Enhanced Incentives to Develop New Efficient Generation Upstate

As alluded to previously reduced UPNY/SENY congestion will create an incentive for new generation to be built Upstate; generation that will be cleaner and more efficient. Increased UPNY/SENY transmission capability will provide more assurance for potential new Upstate generation that it will be able to deliver and sell its output to a wider more robust market. Furthermore, new transmission facilities may facilitate new generation interconnecting with the grid and/or reduce the need for new generation to fund transmission upgrades in order to become eligible to participate in the capacity market.

In the short term, increased UPNY/SENY transmission capability will manifest itself in the form of potentially higher energy prices. Coupled with a lower cost for generators to acquire suitable sites, construct, interconnect, operate and obtain fuel – all of which will presumably be less expensive Upstate - the higher market prices will provide an incentive to build and improve the financial viability of proposed new generation.

Over the longer term, additional generation Upstate will help reduce both energy and capacity costs statewide, will provide needed replacements of existing aging and less efficient generation and will help reduce overall emissions. While it is difficult to quantify this benefit, it is clear that added transmission capability along with attendant reductions in congestion will have an overall positive impact on the development of new generation.

Reduced Environmental Emissions and Improved Health Impacts

Transmission upgrades can reduce many harmful emissions such as SO_2 NO_X, and greenhouse gasses by avoiding the dispatch of high emission generation resources. In New York, many older and higher emitting generation resources are located downstate while many more efficient and renewable resources are located in upstate. Allowing greater transmission access to upstate generation resources can reduce statewide emissions by offsetting the need to run the less efficient dirtier generation downstate. It is understood that sites for large scale renewable generation are limited in southeastern New York. The NYISO is already experiencing constraints to the delivery of wind and hydro resources located in UPNY to SENY. From 2005 to 2014, the generating capacity of wind resources in New York grew approximately 1,700 MW. Additional wind projects capable of supplying another 2,300 MW of power are currently proposed for future interconnection with the bulk electricity grid. All of the existing and proposed wind power capacity is based in western and northern New York.[37] In order to make these new resources available to the greatest extent across the state, it is necessary to increase the transmission capacity into SENY.

Avoided Refurbishment Costs of Aging Transmission

One of the most significant benefits associated with many of the proposed transmission system upgrades is enhanced efficiency due to avoided refurbishment costs of aging

[37] NYISO Interconnection queue, NYISO comments Case 14-E-0454; Why a Robust New York Transmission Grid is Required.

infrastructure. As outlined in the Energy Highway blueprint and identified the NYTO STARS report and elsewhere, today's transmission system is aging and is in need of replacement and rebuilding. The NY STARS report determined that based on a high level age based condition assessment, nearly 4,700 miles, over 40%, of transmission lines will approach their end of life and may require replacement within the next 30 years. The estimated cost of this replacement is more than $25 billion.[38] In particular, key bulk power transmission lines across the constrained Central East and UPNY-SENY interfaces are due for replacement within the next ten years. In fact one of the recommendations of the STARS was that projects including the third Leeds-Pleasant Valley line, third New Scotland–Leeds line and second Rock Tavern-Ramapo line should be pursued. The base cost of replacing these facilities in-kind will likely be required whether or not the system is upgraded. Of the corridors considered in this proceeding, STARS identified several lines needing replacement over the next 30 years. Specifically, lines correlating to project proposals include:

- Porter-Rotterdam 230kV lines: 0-10 years
- New Scotland-Leeds 345kV: 0-10 years
- Leeds-Pleasant Valley 345kV: 0-10 years
- New Scotland-Knickerbocker 345kV: 11-20 years
- Greenbush-Pleasant Valley 115kV: 11-20 years
- Leeds-Hurley Avenue 345kV: 21-30 years

As indicated in the Brattle Report, there are several benefits associated with avoided future refurbishment costs. First is for early refurbishment of aging lines, where a project replaces aging lines identified in the STARS which avoid the cost of replacing those lines in the future. These benefits were monetarily quantified by estimating: (a) savings in O&M

[38] NY STARS Phase II Report p.5

costs, property taxes, etc., that would accrue from retirement of existing aging facilities, and (b) savings that would accrue due to early replacement/refurbishment of facilities that would need to be refurbished in any event due to their age and condition (i.e., the present value of future revenue requirements for refurbishments that would be anticipated in the future). The second type of benefit anticipated would be for projects which create a parallel path that would reduce congestion costs during new facility construction and/or reduce the difficulty in attempting to facility outages to allow construction to progress. These second type of benefits were considered more qualitative and speculative such they were not monetarily quantified for inclusion in the Benefit-Cost analysis.

Increased Tax Receipts from Increased Infrastructure Investment

New infrastructure constructed and operated within the boundaries of municipalities will add to the property tax base there. Over the lifetime of a project, this will increase tax revenue for the municipality thereby allowing an increase in services and/or a reduction in property taxes for residents within that community. The property tax base increase will be the net increase in infrastructure value after deducting the value of any existing infrastructure that will be replaced, retired and removed.

Admittedly, these property taxes will be paid by ratepayers based upon how costs for the project are allocated, and therefore represent transfer payments within New York. However, the property taxpayers in affected municipalities will not necessarily be the same as the affected ratepayers. Therefore property tax receipts are considered benefits accruing to the former, and property tax payments are considered costs for the latter group.

Likewise, revenue requirements associated with the construction of new infrastructure include the cost of income tax paid to New York by ratepayers through the cost allocation process. As with increased property taxes, these also represent transfer payments. They provide an offsetting benefit in the form of additional tax receipts which can increase tax revenue for New York and/or allow income taxes to be reduced for taxpayers within New York.

Increased Employment

Construction and operational jobs for new projects – along with the increased probability that new generation will be sited in Upstate New York due to reduced levels of UPNY/SENY congestion - would result in both temporary construction and permanent O&M jobs. This in turn will help maintain better financial health/viability for Upstate communities. While these potential impacts are not quantifiable, they do represent a benefit of any Commission selected project and should factor into any decision regarding a public policy need.

Enhanced Resiliency/Storm Hardening

Upgrading the transmission infrastructure has the clear benefit of enhanced resiliency during extreme weather conditions and storms. This includes traditional challenges presented by summer peaks on hot days, as well as less familiar issues which can arise during extreme cold weather or winter events, such as ice storms or the polar vortex in 2014. The PSC approved a significant budget for storm hardening and resiliency measures for the Consolidated Edison electric system in NYC following the crippling effects of Superstorm Sandy in 2012.

Continued action in storm hardening and resiliency is imperative throughout the rest of the state to be prepared for the increasing effects of severe weather. Maintaining, replacing, and upgrading the states transmission facilities is necessary to support these efforts. Further, increased transmission capacity from upstate to downstate would help increase diversity of resources available to SENY as well as increase the flexibility and resilience of the bulk power system.

Enhanced Planning and Operational Flexibility

Increased transmission has beneficial effects on operational flexibility of the electric grid and allows for more enhanced planning both in the short and long term. Increased transmission provides the NYISO, the bulk electric system operator, greater operational flexibility by facilitating the dispatch of resources located throughout the grid, as well as react to system outages and contingencies effectively. It also provides increased access to operating reserves and ancillary services, as well as more easily allowing lines to be taken out of service for maintenance when needed. Outage scheduling is a significant challenge for Transmission Owners and the NYISO, and coordination and timing is critical to maintain operations and reliability. When transmission lines need to be taken out of service for maintenance, it can cause increase congestion on other lines which need to make up for the outage, which leads to increased prices during this period.

Other Potential Benefits

Several other potential benefits, albeit less quantifiable, can emanate from increase UPNY/SENY transmission capability along with associated congestion relief as follows:

Synergies with Other Future Transmission Projects

New transmission facilities – including the construction of new substations – may facilitate the ability to further expand the electric transmission and distribution system as additional needs may arise. For example, new or upgraded substations can potentially reduce the cost and/or make it easier to further expand the electric system to help meet future growth and reliability needs.

The primary driver for this proceeding was to increase the UPNY/SENY transfer capability by at least 1,000 MW. However, the synergistic impact of transfer capabilities on other transmission interfaces such as Central-East and New York-New England are also important facets to be considered.

Relief of Gas Transportation Constraints

In many respects the gas transportation system and electric transmission system complement and substitute for each other. As more generation shifts to gas-fired resources, the gas transportation system has become more congested, leading to spikes in natural gas prices – which then also cause electric prices to spike. To the extent that electric transmission capability is increased, it can off-load the gas transportation system and reduce the number and duration of costly gas price spikes. Similarly, it will allow presumably less expensive and more easily constructed gas infrastructure to be built Upstate as opposed to Downstate, thereby substituting Upstate generation and electric transmission for Downstate generation and gas transmission.

Improved Market Competition and Liquidity

Electric transmission is essentially a "market equalizer" which expands the size and efficiency of the market. When transmission is constrained, the market may be divided into load pockets (import limited areas in which local load is heavily dependent on a limited amount of relatively high-cost local generation) and generation pockets (export limited areas in which relatively low-cost generation becomes underutilized, or "bottled"). Transmission upgrades reduce import and export constraints, thus permitting distant generation to compete effectively with local generation. Besides improving overall efficiency and reliability, this may result in elimination of the need for Reliability Support Services Agreements (RSSAs) in which local load needs to be supplied by relatively high-cost local sources.

Market liquidity refers to the ease buying or selling electricity. By expanding the size of the market, transmission upgrades increase the effective number of buyers and sellers in each market, thereby improving market liquidity. This greater liquidity reduces market power and helps ensure efficient, competitive outcomes.

Fuel Diversity

Due to the great abundance and low cost of natural gas, the majority of new generation being interconnected to the bulk transmission system is gas-fired. Over dependence on natural gas becomes a concern when such a significant amount of generation is reliant on such a single fuel source. Prudent planning suggests that a diverse fuel resource mixture is advantageous to guard against major contingencies or disruptions in fuel delivery. Today the majority of electric generating units running on natural gas in New York do not receive firm delivery rights and therefore could be curtailed by natural gas suppliers if adequate supply is unavailable. Fortunately, on a statewide basis, New York has a relatively diverse portfolio of generation resources, including hydro, nuclear, and wind generation. However, most of the State's diverse resources are located in upstate, while downstate generation is comprised primarily of fossil units that burn natural gas and fuel oil. Moreover, the available generation supply in upstate New York exceeds the regions peak load, whereas in downstate New York the reverse is true, with the summer peak being in excess of the downstate generation resources. Adding transmission capacity would help mitigate this concern by allowing the State to take better advantage of its fuel diversity.

Quantitative and Qualitative Benefits

Within this proceeding, some potential benefits were estimated and quantified based upon lifetime monetary savings. These included production cost savings, capacity savings, avoided refurbishment costs, reduced costs of meeting the RPS, and increased income and property tax revenue. Other potential benefits such as reduced environmental emissions and improved health impact, and increased employment were quantified but not translated into monetary amounts. The remaining identified potential benefits were not quantified, but rather were qualitatively described.

Costs of Achieving Benefits

Lifetime Monetary Costs of Implementation

The monetary costs associated with proposed projects include the initial implementation cost of the project plus the associated lifetime costs to support and make use of that investment. These costs were translated into present valued and annually levelized revenue requirements consisting of: (a) return on investment (ROI); (b) depreciation; (c) operating and maintenance (O&M) costs; (d) working capital; (e) property taxes; and (f) state and federal income taxes. The revenue requirements for each alternative were directly proportional to their estimated original capital investment costs.

Environmental Impacts

In addition to an estimate of monetary costs, each proposal was evaluated with respect to its relative environment impact. These impacts were compared in terms of (a) length of route; (b) new ROW needed; (c) expansion needed of existing ROW; (d) need for and types of river crossings; (e) new substations or switching stations needed; (f) need for expansion of existing substations and switching stations; (g) additional land needed for new substations and switching stations; (h) proximity to State and National Register of Historical Places (S-NRHP); (i)distance crossing federally-jurisdictional wetlands from National Wetlands Inventory (NWI); (j) State-regulated streams crossed by ROW; (k)distance in 100 year floodplain areas crossed by ROW; (l) length of ROW in NYS Agricultural Districts; (m)forested wetlands and total forest areas disturbed by ROW development; (n) number of residences within 250 feet of proposed facility locations; (o) overall construction and operational noise; and (p)potential for aesthetic visual impact.

Based upon a quantitative and qualitative evaluation of these environmental criteria, each proposal was ranked as "Low", "Medium" or "High" with regard to its overall environmental impact as follows:

- Low Impact – most environmentally compatible; albeit potentially still having significant environmental impact requiring mitigation
- Medium Impact – less environmentally compatible
- High Impact – least environmentally compatible.

The approach as recommended by Trial Staff selected the segments that best meet these goals.

MAPS and Power Flow Analysis

Following the filing of Part A proposals in January 2015, Trial Staff asked the NYISO and Brattle to analyze benefits and costs of the transmission proposals, including Power Flows, system impacts and Benefit/Cost ratios of each of the respective proposals. The initial results of the Power Flow analysis were included in the Interim Report.

This analysis has been updated to include the CPV Valley generating facility in the base case. The presence of CPV Valley on the bulk power system, running at full output, resulted in some of the proposed transmission projects providing less transfer capability across the UPNY/SENY Interface (See, e.g., P7, P9, P12, and P14 in Figure 9, below). Because of the location of CPV Valley, its power flows onto the Leeds-Pleasant Valley corridor, effectively reducing the ability of proposals using this corridor to move power from UPNY-SENY. The power flow simulations showed that the presence of CPV Valley increased the transfer capability of lines running from Knickerbocker/Greenbush-Pleasant Valley however, because some of CPV's output flows north via the Marcy South Lines and returns from UPNY-SENY through the New Scotland-Alps line and ultimately the Knickerbocker/Greenbush-Pleasant Valley corridor (See, e.g. P6, P11, P19a in Figure 9).

As explained in the Executive Summary, 22 proposals were described in the Interim Report. Using a screen of 900 MW for UPNY-SENY, Projects 6, 9, 11, 14, and P19a were selected for further analysis. When this screen was used along with the low/medium environmental screen, and the 1.0 Benefit/Cost ratio screen (including production cost savings estimated using the MAPS model and factored into the Brattle's Benefit/Cost ratio estimates), projects were eliminated from consideration and the attributes provided by Project 11 are being recommended for adoption.

MAPS/Power Flow Review Process and Brattle Role

To estimate wholesale energy market impacts from transmission upgrades, and the costs and benefits derived there from, Brattle started by using General Electric's Multi-Area Production Simulation model (MAPS) computer software tool to perform simulations of the electric energy market. This involves simulating the electric system under business as usual conditions and to forecast wholesale energy market impacts resulting from changes to the electric system, such as transmission resource improvements.

MAPS is an industry recognized electric system planning and analytics tool. It relies on many detailed inputs, including forecasts of electric demand and fuel costs, generating unit characteristics (e.g., heat rates, forced and planned generator outages, and emission rates), and the electric transmission system topology.

The Base Case is a "business-as-usual" scenario. In this proceeding, the Base Case means a scenario in which no new transmission is built or refurbished, beyond those refurbishments that have already been planned or are under construction. Each alternative scenario, or Change Case, incorporates into the Base Case a transmission resource upgrade, for example, a new 345-kV transmission line in the Hudson Valley corridor from UPNY to SENY. Wholesale energy market impacts are estimated relative to the business as usual Base Case.

Wholesale energy market impacts refer to standard metrics that are typically used to quantify benefits associated with proposed changes to the electric system. These include estimates of the costs of producing electricity, consisting of fuel and variable operations and maintenance costs, and referred to as production costs. They also include air emissions impacts, and forecast changes in the wholesale energy component of electric prices, referred to as location based marginal prices (LBMPs). Retail rate impacts are estimated based on the LBMPs that are forecast using MAPS. All of these metrics ultimately inform the Benefit/Cost analysis for a given Change Case.

In addition to modeling transmission upgrades, MAPS is used to estimate wholesale energy market impacts from non-transmission alternatives. This includes the modeling of a combined cycle gas fired generation alternative, and using forecast LBMPs from the Base Case to develop impact estimates related to a REV alternative described above. The REV alternative consists primarily of increased energy efficiency along with additional distributed generation resources. In order to be consistent with the transmission modeling, these non-transmission alternatives are assumed to be located in SENY.

The MAPS data used in this proceeding was originally assembled by the NYISO for its CARIS economic planning process. The NYISO MAPS input data and assumptions are developed on an on-going collaborative basis with energy market participants. Using agreed upon input data and assumptions, the NYISO uses the MAPS software to perform electric energy market simulations of Base Case and other scenarios as described in the NYISO’s CARIS Reports.

The MAPS analysis described here was done by Brattle in consultation with the NYISO and Trial Staff. NYISO provided its MAPS data to Brattle pursuant to a confidentiality agreement so Brattle could use it as the basis for performing energy market simulations and analyses of resource changes such as transmission upgrades. Brattle used the MAPS model to simulate transmission portfolios proposed by the four Applicants.

Before a MAPS simulation for any scenario was performed, however, each portfolio was assessed for reliability and system impact implications. These assessments provide information on reliability including what is referred to as Power Flow data. These data are a required transmission topology input data set for the MAPS model. Furthermore, these reliability assessments identify the degree to which transmission capability changes at various locations on the electric system as a result of a given transmission upgrade. For the analysis described here, the key transmission points include what is referred to as the UPNY-SENY transmission interface, and the Central East transmission interface.

The Power Systems Studies Group of TRC was hired as a consultant to work with the NYISO to develop reliability assessments for each transmission proposal. These assessments ensure that each scenario that is modeled using MAPS is reasonable in terms of the ability of the power system to deliver electricity to consumers in sufficient quantity and quality.

TRC and the NYISO’s analysis without the proposed CPV Valley generation facility included was reported in the Interim Report. For comparison purposes, those results, together with Power Flow results that do include CPV Valley are presented in the table below.

Figure 9: Comparative Evaluation Power Flow Results w/ CPV Valley – UPNY/SENY (MWs) (Source: NYISO)

PROJECT SCENARIOS	UPNY/SENY NTC Limit Increase w/o CPV	UPNY/SENY NTC Limit Increase w/ CPV	Delta	UPNY/SENY ETC Limit Increase w/o CPV	UPNY/SENY ETC Limit Increase w/ CPV	Delta
P1 - NAT	1,729	2,106	377	2,722	2,385	(337)
P2 - NAT	1,179	1,710	(69)	2,122	2,271	149
P3 - NAT	1,717	2,138	421	2,657	1,709	(948)
P4 - NAT	933	1,463	530	1,203	2,227	1,024
P5 - NAT	959	1,524	565	1,880	2,101	221
P6 - NYTOs	656	918	262	1,544	1,686	142
P7 - NYTOs	1,243	352	(891)	1,243	1,404	161
P8 - NYTOs	(469)	(330)	139	116	236	120
P9 - NYTOs	1,351	1,038	(313)	1,598	2,091	493
P10 - NYTOs	638	1,206	568	1,507	1,907	400
P11 - NYTOs	603	939	336	1,469	1,621	152
P12 - NYTOs	1,200	432	(768)	1,200	1,341	141
P13 - NYTOs	(677)	(329)	348	(108)	215	323
P14 - NYTOs	1,500	1,136	(364)	2,460	2,286	(174)
P15 - NextEra	874	TBD	TBD	1,780	TBD	TBD
P16 - NextEra	697	TBD	TBD	1,587	TBD	TBD
P17 - NextEra	817	TBD	TBD	1,653	TBD	TBD
P18 - NextEra	558	TBD	TBD	1,436	TBD	TBD
P19a - NextEra	697	961	264	1,528	1,747	219
P19b - NextEra	TBD	TBD	TBD	TBD	TBD	TBD
P20 - Boundless	588	687*	99	588	1,753	1,165
P21 - Boundless	482	605*	123	482	1,433	951

* For P20 and P21, the stuck breaker contingency is ignored
+Base Case w/o includes Athens SPS, change cases do not.
TBD: These figures will be provided prior to the Technical Conference to follow this Final Report and numbers will include NextEra's proposals for these scenarios without Oakdale-Fraser but with CPV Valley in the Base Case.
De Minimis: This figure was determined by the NYISO in its judgment to be negligible, as such, no further analysis of this segment was conducted.

Further details regarding these Power Flow results are contained in Appendix 2. In conducting Power Flow Analyses with CPV Valley included, the NYISO determined that all projects, with the exception of those proposed by Boundless, trigger a contingency on the Orange and Rockland Chester-Shoemaker line, which must be bypassed for any of the projects to produce a positive benefit. In other words, if the Sugarloaf to Chester line is not upgraded, the transmission project recommended by Trial Staff would not be able to operate at full capacity as the Sugarloaf to Chester line is limiting.

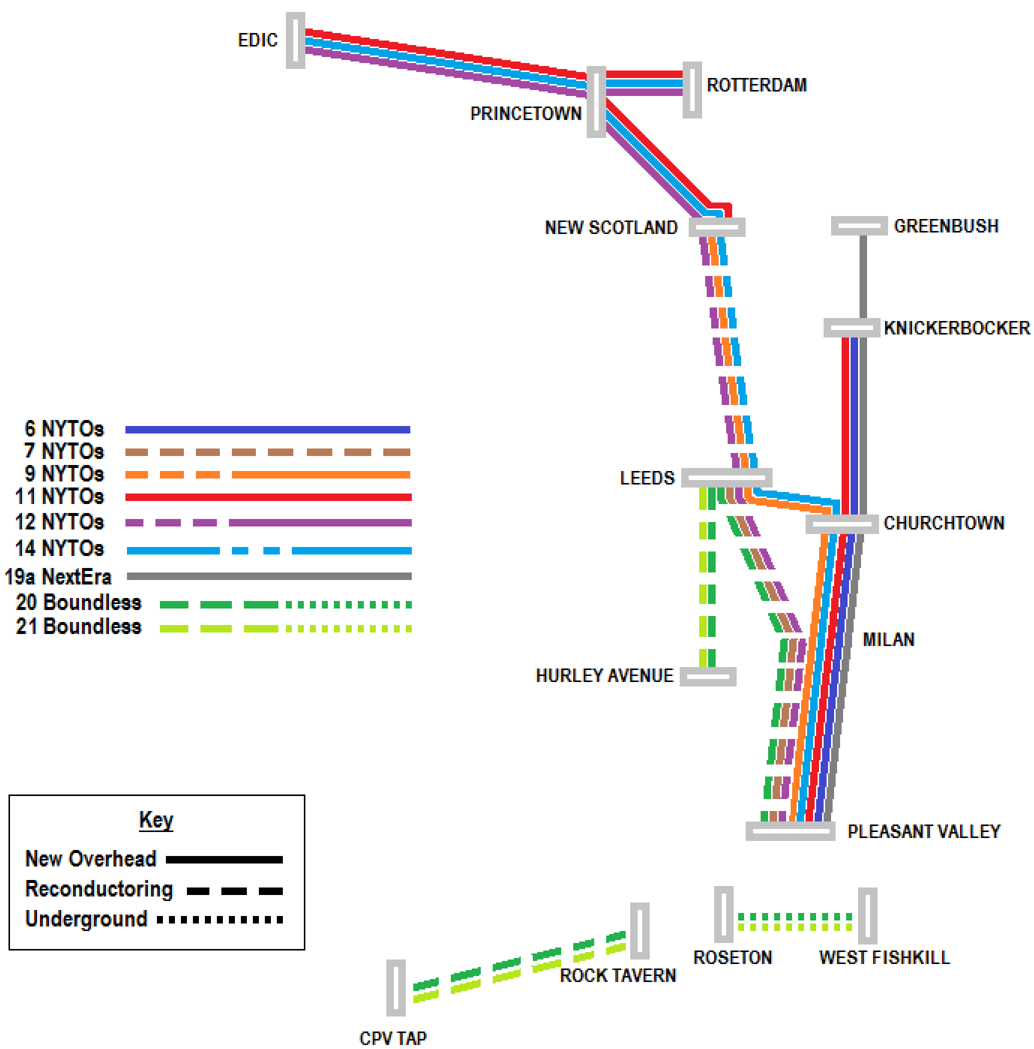
NYISO studies have identified a need to upgrade the Sugarloaf to Chester 69 kV line to a 138 kV line with larger conductors. The existing double circuit 69 kV Sugarloaf line was constructed on steel lattice towers dating back to the 1920s. These towers need to be updated to handle a larger conductor and to be able to meet the latest edition of the NESC and the Civil Engineering standards. In addition to constructing a new line(s) there will be station upgrades necessary to interconnect the line to the existing 69 kV substations and to meet new construction standards as well as other required system upgrades to accommodate the new line. There are 5 substations that need to be upgraded which include South Goshen, Hartley, Sugarloaf, Shoemaker and Chester.

The terminal upgrades at Rock Tavern involve equipment that must be changed to handle higher line currents that will result as a consequence of the upgrades recommended by Trial Staff. They include new line traps, relays, potential transformer upgrades, switch upgrades, system control upgrades and the installation of data acquisition measuring equipment and control wire.

These upgrade costs which are mentioned above in connection with Trial Staff’s cost estimates, are assumed to be applicable to all NAT, NYTO, and NextEra proposals.

Running MAPS simulations is time consuming and resource intensive. Based on the Power Flow characteristics and features of all of the transmission scenarios, Trial Staff, in concert with the NYISO and Brattle, selected nine projects to further examine. These projects represent a sample of those projects that run to the east and west of the Hudson River as well as those projects that include a segment between the Marcy or Edic and New Scotland substations and those that do not. The projects selected for further review were Scenarios 6, 7, 9, 11, 12, 14, 19a, 20, and 21. A graphic representation of these projects is contained in the figure below.

Figure 10: Scenarios Chosen for MAPS Analysis



These projects were chosen based on Trial Staff's Interim Report conclusions as well as the updated Power Flow results discussed above. Other projects taking similar or identical routes were assumed to have the same or similar system impacts and cost benefit results by Brattle. The power flow characteristics of these projects are as follows. Note that the change in Central East transfer limit used in the Brattle analysis is the MW impact under the heading "Central East Voltage Impact" in the Comparison of Central-East Transfer Limits chart, since Central-East is a voltage-limited transmission interface.

Figure 11: Detailed UPNY-SENY Power Flow Modeling Results (MW) (Source: NYISO)

PROJECT SCENARIOS	UPNY SENY Base Case w/ CPV	UPNY SENY w/Project NTC	UPNY SENY NTC Limit Increase	SENY N-1-1 Delta	UPNY-SENY Emergency N-1	Central East Effective Limit w/o CPV	Central East Effective Limit w/ CPV	Central East Delta
P6 – NYTOs	5113	6031	918	790.8	1686	292	100	(192)
P7 - NYTOs	5113	5465	352	392.0	1404	(24)	25	51
P9 - NYTOs	5113	6151	1038	969.9	2091	292	50	(242)
P11 – NYTOs	5113	6052	939	793.8	1621	412	375	(37)
P12 – NYTOs	5113	5545	432	635.0	1341	617	375	(242)
P14 – NYTOs	5113	6249	1136	973.1	2286	617	375	(242)
P19a – NextEra	5113	6074	961	860.2	1747	317	50	(267)
P20 – Boundless	5113	5800*	687*	365.1	1753	217	-25	(242)
P21 – Boundless	5113	5718*	605*	283.3	1433	217	-25	(242)

Notes on All Cases:
- Assumes limitation on Shoemaker-Chester-Sugarloaf 138 kV line has been addressed.
- Assumes Rock Tavern terminal upgrades are included in all project cases
- For P20, the Gilboa-Leeds limit is ignored due to an NYSRC exception allowing the line to be secured to STE when 4 Gilboa units are on.
-Assumes Athens SPS is in Base Case, but not change cases.
* For P20 and P21, the stuck breaker contingency is ignored.

Brattle conducted MAPS simulations for the years 2019 and 2024. Interpolation between these years was used to develop forecasts for the years 2020-2022. Also, extrapolation was used by multiplying year-2024 estimates by the forecast annual rate of inflation to estimate impacts during 2025 through 2063.

Generally, the forecast production cost impacts using MAPS show benefits that are presumed to be understated.[39] Brattle, in consultation with the NYISO and the Trial Staff, developed multiplier factors to scale up the production cost

[39] Appendix 1, Slides 83-89.

impacts estimated using MAPS. These multipliers are intended to account for factors that are not fully captured in MAPS, such as transmission outages and extreme weather events. Use of multipliers was necessary in part due to time constraints since using MAPS to do additional sensitivity analyses, for example, is time and resource intensive.

For transmission, the multiplier factor is 1.6, based on a comparison of zonal LBMP differentials, forecast using MAPS, to zonal LBMP futures price differentials in Western New York (Zone A) and the Upper Hudson Valley (Zone G). A factor of 1.25 was developed for generation, based on a ratio of market heat rate spreads between Zone G prices forecast using MAPS and LBMP futures. For the REV alternative, the factors range from 1.03 for the Hudson Valley (LBMP Zones G-I), and 1.06 for New York City (Zone J). The REV factors are based on the resource location and differences in zonal LBMPs between what Brattle forecast using MAPS and LBMP futures.

Forecast air emissions impacts in tons of SO_2, NO_x, and CO_2 show relatively small impacts. They are shown in the Brattle Report attached as Appendix A slide 75 for New York only and for New York and nearby regions.

Changes in wholesale energy market prices — LBMPs — forecast using MAPS were incorporated into the ratepayer impact analysis. This involved making assumptions to reflect price certainty measures that transmission owners and generation owners use to mitigate price volatility.

Air emission impacts resulting from each alternative could be expected to persist over the long-term. Wholesale price impacts, in contrast, tend to be shorter-term, meaning that they can be expected to decline and diminish over time as market participants (suppliers and consumers) adjust their behavior in response to the immediate change in prices expected to result from generation resource changes. These behavioral reactions to price changes were not simulated in the MAPS modeling.

The generation and transmission resources of four regions, typically referred to as control areas, are modeled using MAPS. In addition to New York, these include New England, Ontario, and the Pennsylvania-Jersey-Maryland interconnection (PJM), which extends west into Ohio and south into Virginia. Quebec is not modeled explicitly but is modeled via non-synchronous interties.

As stated above, the MAPS data originated from the NYISO "2014 CARIS 2" process. It was revised by the NYISO to incorporate supply assumptions from the NYISO "2014 Comprehensive Reliability Plan" (March 2015). The NYISO also incorporated 1,000 MW of wind generation to meet RPS requirements. Brattle revised the MAPS input data further, with NYISO oversight. The revisions included incorporating forecast natural gas prices based on current futures prices, New York State load forecasts from the 2015 NYISO Load & Capacity Data report (2015 Gold Book), and both load and generation expectations in neighboring regions to be consistent with currently available forecasts from the PJM, the New England Independent System Operator (ISO-NE), and the Ontario Independent Energy System Operator (IESO).

For each group's representative transmission portfolio, production cost sensitivities were performed. The Low Value Case reduces the multiplier factor to 1.2, from 1.6 in the Base Case. The High Value Case increases post-2024 production cost benefits at inflation plus one percent. The net present value estimates changed by a small amount.

Additionally, an Indian Point retirement scenario was simulated using MAPS. The Base Case for this was assumed to be

Indian Point out-of-service with combined cycle generation incorporated to replace Indian Point's current capability, referred to as IP-Out Base Case with Compensating Generation. In the Change scenario, referred to as IP-Out with TransmissionTx Solution, Indian Point is assumed to be out-of-service with a representative transmission portfolio simulated and no replacement capacity simulated from other resources.

Overview of Economic Impact Analysis

The primary metric for estimating the economic benefits of transmission upgrades is the reduction in the cost of generation, referred to as Production Cost Savings (PCS), permitted by the increase in transfer limits. In the short run, the economic benefits are due to changes in the dispatch (operation) of existing generators: the increased transfer limits permit more of the load in SENY to be served by existing lower-cost generation in UPNY. The shift in production to generators with lower production costs (primarily lower fuel costs) represents an improvement in efficiency and a reduction in economic costs. For example, suppose the cost of energy averages $40/MWh in central NY but $50/MWh in SENY, due to congestion on the Central-East interface (transmission lines from central NY to eastern NY). A transmission project that increased transfers from central NY to SENY by 350 MW would yield about $30 million in annual production cost savings (350 MW x $10/MWh x 8760 hours/year = $30,660,000/year). Brattle used MAPS to estimate the PCS benefits for 2019 and 2024; these are comparable to the NYISO CARIS metrics for PCS.

The increase in transfer limits provides additional capacity benefits to SENY, especially to the Lower Hudson Valley (Load Zones G, H, and I) and New York City (Load Zone J), collectively the "New Capacity Zone" or "G-J Locality", by permitting more SENY load to be reliably served by lower-cost capacity in Upstate New York rather than higher-cost capacity in SENY. For example, the annual cost of new capacity in upstate NY is estimated to be about $90,000 per MW, compared to about $120,000 per MW in the Lower Hudson Valley and $180,000 per MW in NYC. A transmission project that permitted an additional 1000 MW of SENY load (of which 200 MW are located in NYC) to be reliably served by upstate capacity could provide long-term annual capacity benefits of about $40 million (1,000 MW from upstate to Lower Hudson Valley x $30,000 per MW savings yields $30 million in benefits; and 200 MW from Lower Hudson Valley to NYC x $60,000 per MW in savings yields $12 million in benefits; for a total of $42 million in annual capacity benefits).

The cost of capacity in Upstate NY is lower for two reasons: first, the Cost of New Entry (CONE), based on the cost to build and operate new gas-fired turbines, is lower in Upstate New York than in SENY; and second, there is currently more excess capacity (above minimum requirements) in Upstate New York than in SENY. Brattle estimated the efficiency gains associated with shifting purchases from SENY to Upstate capacity, based on its model of New York's capacity markets. Brattle has also provided the NYISO's CARIS capacity market metrics for comparison; Brattle's net present value capacity benefits are similar to the values from the CARIS "Variant 1" capacity metric (see Slide 103).

The increase in transfer limits provides additional long-term economic benefits by permitting new generation to locate in UPNY and reliably serve load in SENY. Relocating new generation from SENY to Upstate provides both capacity and energy benefits, since Upstate generation typically has a lower cost of capacity (lower CONE) and greater access to lower-cost fuel and renewable resources. While Brattle has accounted for the capacity benefits associated with the relocation of new generation, Brattle has not rerun MAPS, due to the difficulties of modeling what generation would be added and where in each change case, and the time that would have been required for such MAPS runs. Instead, Brattle has assumed that PCS will simply continue at 2024 levels (adjusted for inflation). This is a conservative assumption, since the new location of generation Upstate should provide additional access to lower-cost fuels and renewable resources, which would add to PCS. Brattle has provided a sensitivity analysis in which PCS is assumed to increase 1 percent above inflation annually, post-2024.

The economic benefits of energy (PCS) and capacity discussed above reflect efficiency gains to society from the proposed transmission upgrades. These are expected to be permanent, and to generally increase over time, as noted above. In the long-term, these efficiency gains are expected to flow through to SENY consumers through the reduced need for higher-cost generation in SENY. PCS benefits are flowed through to transmission owners via the sale of Transmission Congestion Contracts (TCCs). Increases in transfer limits permit additional sales of TCCs. The revenues from these TCC sales are available to offset transmission revenue requirements, a component of delivery rates; thus the PCS benefits permit reductions in delivery rates to ratepayers. Capacity benefits, due to the reduced need for higher-cost capacity in SENY, permit reductions in supply costs to LSEs, which are expected to flow through their savings to consumers.

Besides efficiency gains to society, the Commission is also concerned with ratepayer impacts. These can differ from the societal efficiency gains due to short-term impacts on wholesale market prices. For example, the increase in transfer limits can impact wholesale market energy prices, assuming no change in generating capacity. The reduced need for SENY generation could avoid the need for the highest-cost SENY generators to operate, thereby permitting a reduction in the wholesale market price of energy in SENY. In contrast, the increased transfers could lead to higher wholesale market prices Upstate, since more Upstate generation would likely be dispatched, which may lead to higher-cost units on the margin (thus setting higher LBMP energy prices Upstate). Brattle's MAPS analyses for 2019 and 2024 capture these short-term wholesale price impacts, assuming no change in generating capacity.

Brattle's analysis recognizes that ratepayers do not purchase all of their energy at local wholesale market prices: a portion of SENY energy is served by Upstate supply, yielding TCC rents that impact rates. Brattle adjusts for these hedges in estimating energy price and TCC rate impacts separately for Upstate and SENY consumers. However, Brattle does not adjust for the fact that some energy, e.g. NYPA hydropower, is sold at cost-based rates rather than at market prices. Adjusting for the additional hedge provided by NYPA hydropower would moderate the rate impact of short-term increases in Upstate market prices reported by Brattle.

In the long-term, Brattle assumes that suppliers respond to wholesale price impacts by relocating new generation from SENY to Upstate New York, until Upstate and SENY prices revert to Base Case levels. This leads to long-term rate impacts that are comparable to the societal benefits discussed above: wholesale market price impacts fade away, but there remain PCS benefits that are flowed through to ratepayers via the congestion rents from additional TCCs. Brattle assumes that the energy price impacts fade away within 10 to 20 years. Trial Staff notes that there are factors that could lead market conditions to reach equilibrium more quickly than Brattle assumed: for example, aging generation may retire and require replacement regardless of load growth; and state policies favoring renewable resources may take advantage of higher transfer limits to locate more RPS resources Upstate.

In addition, the increase in transfer limits could lower capacity market prices in SENY by permitting a significant reduction in the SENY capacity requirements. However, a significant reduction in capacity market prices is likely to lead to a market response, e.g. by retiring aging units or deferring investment in new units. Moreover, suppliers would know well in advance about the impending reduction in SENY capacity requirements, and would be expected to plan accordingly. Brattle has modeled this market response by employing a sloped supply curve in its capacity market model. As a result, capacity price impacts are moderated, and further diminish over time as load growth (or generator retirements) tightens the SENY capacity market. However, Brattle does not adjust for the fact that some capacity, e.g. NYPA hydroelectric capacity, is sold at cost-based rates rather than at market prices. Adjusting for the additional hedge provided by NYPA hydroelectric capacity would moderate the rate impact of short-term increases in Upstate capacity market prices reported by Brattle.

In the long-term, wholesale capacity market prices are forecasted to reach the CONE, which is generally lower Upstate than in SENY. By reducing SENY locational capacity requirements, increased transfer limits would permit LSEs serving SENY consumers to purchase more of their capacity needs from lower-cost Upstate resources. LSEs would be expected to flow through these long-term capacity benefits to their retail customers.

Brattle's Economic Analysis

Brattle provides an overview of its analysis in slides 2-5. Slide 4 notes that Brattle provided an initial analysis of the proposed projects prior to the announcement by CPV Valley; this prior analysis is presented in an appendix (Slides 137-200). Slide 137 (from the prior analysis) displays the 6 representative transmission portfolios originally selected for detailed MAPS analysis, and slide 138 provides the initial Benefit-Cost results for the projects (prior to CPV Valley).

Slide 7 lists the nine transmission portfolios evaluated following the release of the July 2015 interim report

Slide 8 describes a generic generation alternative, to provide 1,320 MW of new combined cycle gas turbines in Zone G; Brattle notes that this alternative was dropped from consideration based on the prior analysis (without CPV Valley), where it showed negative net benefits (see slides 157-158).

Slide 9 describes a REV alternative, to deploy additional energy efficiency and other resources to reduce SENY peak load by 1,200 MW.

Slide 13 illustrates the Societal Benefit-Cost Results for the nine transmission portfolios plus a REV alternative (based on Trial Staff's capital cost estimates).

Slide 14 provides the detailed Benefit-Cost Analysis Results for the nine transmission portfolios based on Trial Staff's capital cost estimates; slide 15 provides comparable results using the Proponents' cost estimates.

Slide 17 illustrates the sensitivity of the Net Present Value estimates to the assumed discount rate of 9.13 percent (reflecting utility before-tax cost of capital). Using a lower discount rate of 5.6 percent (based on utility after-tax cost of capital) significantly increases NPV and the Benefit-Cost ratios for most projects, due to the front-loading of costs in Revenue Requirements, compared to the longer-term duration of benefits.

Slides 18-20 illustrate the sensitivity of the Benefit-Cost Ratio to various assumptions. The Capacity Resource Savings shows significantly higher Benefit-Cost Ratios in the event of the retirement of 2,000 MW in SENY.

Slides 22-26 illustrate annual potential ratepayer impacts over time. Slide 26 details potential annual rate impacts for one project (P14) over time, showing net decreases in SENY rates of about 0.1 cents/kWh in the short-run (due to lower wholesale energy prices and lower capacity costs) but smaller rate impacts in the long-run, as wholesale price impacts are expected to fade. Slide 26 also shows potential Upstate rate impacts, which initially increase about 0.1 cents/kWh in the short-run, due to higher forecasted wholesale energy and capacity prices; these disappear in the long-run, and Upstate ratepayers are left with net decreases of over 0.1 cents/kWh due to avoided refurbishment costs. These assume all energy and capacity is purchased at wholesale market prices, and thus do not account for the hedge provided by NYPA supply at cost-based rates, which would moderate short-term Upstate rate increases.

Slide 27 estimates real levelized rate impacts (average over 45 years) for SENY and for UPNY. SENY rates are estimated to decrease slightly overall by about 0.05 to 0.1 cents per kWh for most of the transmission portfolios, while UPNY rates are estimated to show negligible impact for P11 and small increases overall (about 0.05 cents per kWh) for the other transmission portfolios.

Slide 28 shows that UPNY property tax receipts are projected to increase. These are separate benefits that are not included in the overall rate impacts because they accrue to particular UPNY municipalities; the corresponding property tax payments are included in the overall rate impacts in prior slides.

Slide 74 details Brattle's estimates of Production Cost Savings over time, in nominal dollars and accumulated net present value, for the 9 transmission portfolios.

Slides 76-79 show forecast air emissions impacts in tons of SO_2, NO_x, and CO_2.

Slides 91-96 describe Brattle's methodology for estimating capacity benefits.

Slide 97 shows the impact of the representative transmission portfolios on locational capacity requirements.

Slides 99-103 illustrate potential capacity quantity and price impacts over time.

Slide 104 summarizes Brattle's estimates of present value Capacity Savings for the 9 transmission projects, the generation alternative and the REV Resource Solution. These estimates are similar to NYISO's "CARIS Variant 1" ICAP metric. NYISO's "CARIS Variant 2" ICAP metric is larger because it assumes large, long-lasting impacts on ICAP market prices.

Slides 109-122 detail avoided future refurbishment costs for the 9 transmission portfolios.

Brattle's Results

With this method and framework, the Brattle MAPS results and subsequent benefit/cost analyses indicate that the 9 projects result in the following benefit/cost ratios. These charts, and supporting materials, are contained on slide 13 in Appendix 1. Brattle's results indicate that 7 out of the 9 scenarios result in positive societal benefit/cost ratios when using both DPS cost estimates.

Figure 12: Brattle Benefit/Cost Ratios for Select Transmission Scenarios (Using DPS Cost Estimates)

Portfolio	DPS Estimated Capital Cost (2015 $m)	PVRR (2015 $m)	Production Cost Savings (2015 $m)	Capacity Resource Savings (2015 $m)	Avoided Tx Costs (2015 $m)	Net RPS Costs (2015 $m)	Total Tax Benefit (2015 $m)	Total Benefits (2015 $m)	NPV (2015 $m)	B/C Ratio
P6 - NYTO	$631	$887	$221	$284	$281	$27	$142	$956	$68	1.1
P7 - NYTO	$361	$508	$194	$284	$70	$31	$104	$683	$175	1.3
P9 - NYTO	$631	$887	$262	$286	$260	$41	$151	$1,001	$114	1.1
P11 - NYTO	$1,189	$1,671	$516	$286	$998	$97	$151	$2,049	$377	1.2
P12 - NYTO	$1,090	$1,533	$554	$286	$873	$108	$163	$1,984	$451	1.3
P14 - NYTO	$1,218	$1,713	$547	$286	$995	$108	$169	$2,105	$392	1.2
P19a - NextEra	$461	$648	$221	$285	$264	$27	$87	$884	$236	1.4
P20 - Boundless	$918	$1,291	$128	$288	$157	$17	$264	$854	-$436	0.7
P21 - Boundless	$671	$944	$115	$288	$76	$17	$193	$690	-$254	0.7

Figure 13: Brattle Benefit/Cost Ratios for Select Transmission Scenarios (Using Applicants' Cost Estimates)

Portfolio	Proponent Estimated Capital Cost (2015 $m)	PVRR (2015 $m)	Production Cost Savings (2015 $m)	Capacity Resource Savings (2015 $m)	Avoided Tx Costs (2015 $m)	Net RPS Costs (2015 $m)	Total Tax Benefit (2015 $m)	Total Benefits (2015 $m)	NPV (2015 $m)	B/C Ratio
P6 - NYTO	$617	$867	$221	$284	$279	$27	$138	$949	$82	1.1
P7 - NYTO	$359	$505	$194	$284	$69	$31	$103	$682	$177	1.3
P9 - NYTO	$635	$893	$262	$286	$260	$41	$153	$1,002	$109	1.1
P11 - NYTO	$1,194	$1,679	$516	$286	$998	$97	$153	$2,050	$371	1.2
P12 - NYTO	$1,105	$1,553	$554	$286	$870	$108	$167	$1,984	$431	1.3
P14 - NYTO	$1,239	$1,741	$547	$286	$991	$108	$175	$2,106	$365	1.2
P19a - NextEra	$386	$543	$221	$285	$251	$27	$66	$849	$306	1.6
P20 - Boundless	$737	$1,036	$128	$288	$112	$17	$212	$757	-$278	0.7
P21 - Boundless	$510	$716	$115	$288	$38	$17	$147	$605	-$112	0.8

The key components of the benefits derived from these projects are Production Cost Savings, Avoided Future Refurbishment Costs, Capacity Resource Cost Savings, Tax Receipts, and Emissions Reductions.

The Benefit/Cost metric, however, should not be viewed in a vacuum, but holistically with Trial Staff's own environmental analysis and Brattle's ratepayer impact analysis. The impacts to ratepayer of one project, Scenario 12, are contained in the figures below. These figures indicate that the ratepayer impacts associated with these projects appear to present the potential for minor rate increases for ratepayers in Upstate New York, but substantial savings for SENY ratepayers currently paying the costs associated with the congestion these projects are designed to alleviate.

Figure 14: Example Ratepayer Impact for Scenario 14 (UPNY)

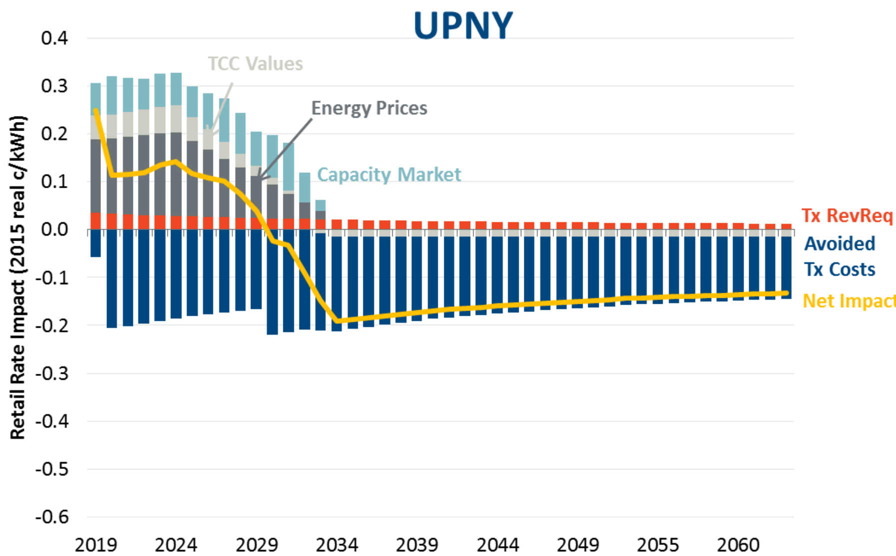
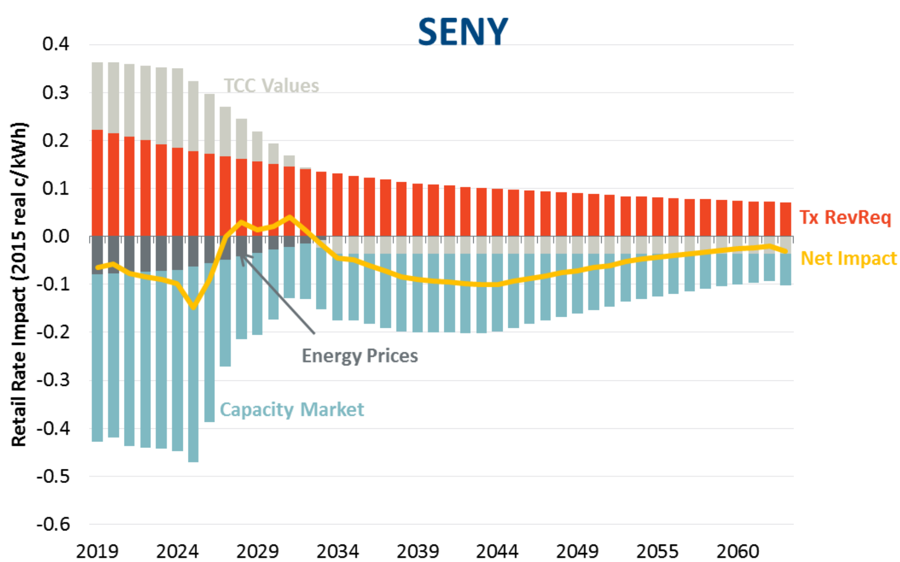


Figure 15: Example Ratepayer Impact for Scenario 14 (SENY)



These figures show that ratepayer impacts are especially pronounced in the early years of the project's operation and are mitigated over the lifetime of the transmission facility. Of note is that UPNY ratepayers receive a benefit in the form of avoided refurbishment costs, mitigating increases in energy prices and capacity market prices. Conversely, ratepayers in

SENY experience a modest decrease in energy prices, but a significant decrease in capacity costs are anticipated.

Additional information regarding the assumptions underlying both the ratepayer and societal benefit/cost ratios are contained in detail in Appendix 1.

Sufficiency of Need

Taking other attributes such as environmental concerns into account, a potential transmission project may be cost effective if the present worth of expected lifetime savings exceed the present worth of expected lifetime costs (i.e., if the benefit to cost ratio exceeds 1.0), taking into account all of the public policy needs factors outlined above. The savings produced by a project amount to the change in costs with and without the project in service. The major quantifiable monetary savings for these projects essentially consist of: (a) congestion savings (energy production cost savings); (b) capacity savings; (c) avoided refurbishment costs; and (d) reduced cost of meeting the RPS. The associated costs include the initial implementation cost of the project plus the associated lifetime costs to support and make use of that investment. Cost effectiveness is not dependent on the absolute level of savings expected; but rather on the expected level of savings produced by a project relative to the associated costs of that project.

Applicants were asked to propose projects that provided approximately 1,000 MW of additional capacity to SENY. Any scenario that increases capacity across the UPNY/SENY interface results in increased transmission capacity to Downstate New York including New York City (which consumes approximately 58 percent of New York State’s electrical energy, and represents approximately 66 percent of capacity needs over the summer peak), thereby providing some benefit to ratepayers in the form of less congestion and potentially lower rates. However, increased transfer capability in and of itself is not enough to recommend any particular scenario. To that end, any project that also results in low-to-medium environmental impact compared to other projects capable of providing the same or similar amount of increased capacity and results in a positive societal cost-benefit ratio may be considered by the Commission to meet this congestion need and therefore proceed to further Commission or NYISO evaluation.

Environmental Impact Analysis and Ranking

Trial Staff evaluated environmental factors for each of the 22 scenarios proposed by the Applicants. The review was based primarily on the information provided by each of the Applicants in their January 19 and March 2, 2015 Part A Application filings and comments made at the Technical Conferences on July 21, 22 and 30, 2015.

Ranking Method

Table 1, "Comparative Environmental Parameters" provides a comparative summary of several major environmental factors for each of the 22 scenarios proposed by the Applicants. Table 1 includes data provided by the Applicants in their Part A filings. Where data gaps existed, Trial Staff augmented the table in order to complete the comparisons and additional information has been submitted by the applicants eliminating missing information. Additional discussion of revisions of Table 1 can be found in the earlier section *General Information Regarding Environmental Review*.

A brief description of the environmental factors presented in Table 1 is provided as follows:

- "Length of Route(s)" is the total length of the proposed ROW. The total ROW lengths are identified in this column, and when zero appears in this column work is proposed at a substation only.
- "New ROW" identifies where projects will be located where there is no existing ROW. New ROW will require property acquisition, vegetation clearing, and construction of access roads, followed by installation of transmission facilities. Property acquisition may involve land purchase or easements from property owners, including the New York State utility operators that comprise NYTO and private land owners. Access roads may require stream and wetland crossings to the extent practical to support construction and operation of the transmission line.
- "Expansion of Existing ROW" identifies where a project will widen an existing ROW (transmission, highway or railroad ROW). A project in an expanded ROW will require property acquisition, vegetation clearing and grading, but may utilize existing access roads.
- "Major River Corridors" identifies potential effects on resources at the Mohawk River/Erie Canalway National Heritage Corridor and the Hudson River and the Susquehanna River. Effects are based on proposed design and installation (overhead or underground); use of existing or new ROW; whether regulatory considerations such as coastal zone or LWRP criteria apply; and whether identified scenic areas or historic resources are potentially affected.

    a) Low rated scenarios will not require new facilities crossing of the Hudson River or Mohawk River / Erie Canalway. Reconducting of existing crossings of the Hudson River or Mohawk River/Erie Canalway on existing structures are also rated as low due to limited construction work and little change in visibility. Bridge attachment of conductors will also be rated as low.

    b) Medium rated scenarios involve in-kind replacement of existing transmission towers on the Hudson River and Mohawk River/Erie Canalway in the existing ROW and construction of additional transmission towers entirely within existing ROW including at the Susquehanna River.

Medium ranking scenarios include underground crossings of the Hudson River via HDD at or near Schodack Island or at Roeston, due to reduced impacts on the SASS.

c) High rated scenarios will require new crossings of the Susquehanna River, the Hudson River, or Mohawk River/Erie Canalway at new locations or where forest clearing is required. An HDD crossing of the Hudson River at Athens-Greenport or Lloyd-Poughkeepsie may cross important fisheries or habitat areas, or the overhead facility approaches to the HDD crossing will be within or directly visible from a SASS.

- "New Substation or Switchyard" applies to projects that will require construction of a new substation or switchyard. This includes proposals to construct a substation or switchyard that has been previously proposed, such as Knickerbocker, but never constructed, and proposals to construct entirely new substations (e.g. Orchard Hill or Princetown Substations).

- "Substation or Switchyard with Expanded Footprint" applies to all of the projects. The footprint expansion may be accommodated within the existing substation yard (area inside the fence) or the yard and fence line may need to be expanded into areas already controlled by a utility company.

- "Land Needed for Substation or Switchyard" applies to projects that will require acquisition of new land (Orchard Hill). The Princetown, Knickerbocker, and North Churchtown switchyards or substations are all proposed for land currently controlled by a utility company; however an applicant will have to acquire property from that utility company.

- "S-NRHP Crossed or Within 1 Mile" represents New York State and National Register of Historic Places (S-NRHP) listed properties located within one mile of the selected ROW. Variations in the estimated number of designated sites within a mile of the same ROW are caused by use of different compiled data sets and variations in the position of center line or ownership boundaries, due to different mapping sources and rounding of the distances. Trial Staff anticipates that where projects are proposed within the same ROW, they will have similar potential impact on designated properties, depending on the final heights of structures.

- ”Distance Crossing NWI Wetlands” is a sum of the total miles of National Wetlands Inventory (NWI) wetlands crossed by the proposed transmission facility ROW. These wetlands include the DEC freshwater wetlands. Trial Staff is unaware whether these wetlands will be crossed by access roads within an existing ROW; however, routine clearing activities within these wetlands will be required. The rating matrix represents Trial Staff’s assumption that ROW with more NWI wetlands will have more activities occurring in or near the wetlands.
- “Regulated Streams Crossed by ROW” includes all water courses with regulated stream classifications. The rating matrix reflects Trial Staff’s assumption that a ROW with more streams will require more activities occurring in or near the streams.
- ”Distance in the 100 YR Floodplains” is a sum of the total miles of 100-year floodplain crossed by the ROW. Projects with greater distances of crossings will have greater potential flood risks requiring mitigation such as flood-proofing or spanning the floodplains.
- “Length of ROW in Ag Districts” is the total distance of Agricultural Districts crossed by the ROW. Designation of an Agricultural District indicates both that counties have taken measures to protect agricultural land by the establishment of Agricultural Districts and that there is active agricultural production in the area. Projects occupying “New ROW” or requiring the expansion of an existing ROW may inhibit agricultural uses within these districts.
- “Forested Wetlands” and “Total Forest” represent forested areas that are currently undisturbed by ROW development. “Forested Wetlands” are more highly valued as an ecosystem since they are more environmentally stable. Total forested area and wetland forest was compiled from the 2011 Land Cover data set. The 2011 Land Cover is a federal geographic information system (GIS) mapping effort to produce and update on a regular basis land use maps for regional planning efforts and resource analysis. The 2011 Land Cover mapping identifies multiple categories of

vegetated and developed land. The potential for changes to "Forested Wetlands" or "Total Forest" may result in conversion of habitats and long term changes in the ecosystem, which may be harmful to both plant and animal species and will change the visual character of the ROW.

- "Residences Within 1-250 Feet" is the total number of residences located within 250 feet of the proposed project. Residences located in close proximity to the ROW and/or project may be impacted by construction, operation and maintenance of the proposed facilities.

- "Overall Noise Impact" provides an overall noise impact ranking based upon a preliminary evaluation of construction and operational noise impacts. Construction noise was associated with the following construction activities: trees clearing, construction of new structures, installation of transmission lines, and construction or upgrade of substations and switchyards. Detailed assessments of construction noise for transmission lines are not available and therefore construction noise impacts were evaluated based on the analysis of general factors such as the estimated number of acres that will require trees clearing, the total length that will require construction of new structures, the total length that will require installation of transmission lines and the number of residences within 250 feet of the ROW. The effect of higher background sound levels for scenarios 2 and 15 with significant portions of the ROW running parallel to the Thruway was also considered, as well as the potential for higher noise levels from the Thruway caused by a potential loss of attenuation because of permanent tree clearing for electric facility clearance. Assessments for construction noise from substations are either preliminary or unavailable. Construction noise impacts of substations were associated with the total number of substations or switchyards that will be either built or upgraded and operational noise impacts were associated with the total number of proposed substations requiring pieces of electrical equipment that may have relevant sound emissions, such as electrical transformers. Construction and operational noise impacts were evaluated at a macro level, as follows:

a) Noise impacts from clearing activities were assumed to be directly proportional to the total number of acres of each scenario that will require trees clearing, in conjunction with the number of residences within 250 feet from the ROW.

b) Noise impacts from construction of new structures were assumed to be directly proportional to the total mileage of each scenario that will require new structures in conjunction with the number of residences within 250 feet from the ROW.

c) Noise impacts from the installation of transmission lines were assumed to be directly proportional to the total mileage of each scenario in conjunction with the number of residences within 250 feet from the ROW.

d) Noise impacts from construction of substations were assumed to be directly proportional to the total number of substations and switchyards of each scenario that are proposed to be built or expanded.

e) Assessments for operational noise of substations are either preliminary or unavailable, since location and design characteristics of main noise sources are not defined yet. Therefore, noise impacts from operation of substations were assumed to be directly proportional to the total number of substations that will require electrical equipment that may produce relevant noise emissions.

Noise impacts were relatively and comparatively evaluated among all scenarios and designated as low, medium (med) or high impacts. Results are included in Table 1.

- “Visual Evaluation” considers the context of the scenarios as they relate to the existing pattern of development, locations designated as aesthetic resources and relative number of potential viewers. The visual settings of the scenarios are highly variable due to differences in the character of the land, existing and proposed transmission line structures, and location in the landscape of the new or proposed ROW, and adjacent land use or development. A detailed evaluation of the potential visual impacts for most locations along the 22 proposed scenarios is not feasible due to the factors described above. Individual applicant prepared visual impact reports that provide site specific analysis of a very small number of common visual settings and visual resources near the selected ROW. That information was reviewed by Trial Staff and considered in the qualitative evaluation below.

- Low – Scenarios involving reconductoring or elimination of structures from a ROW. Scenarios that have low numbers of residences adjacent to the ROW and a limited number of visual resources of state or federal concern in or near the ROW. The existing ROW is well screened from viewpoints or there is no change in height, a decrease in height resulting in decreased visibility of the facilities compared to existing structures, or an increase in height of less than 10 feet. The ROW has limited forest cover, which will limit the change in the visual character when the ROW is cleared of tall growing species.
- Medium - Scenarios built within existing transmission ROW. The number of residences near the ROW is medium, a moderate number of visual resources of state or federal concern are located near the ROW, or a low number of especially significant aesthetic resources may be affected by the proposed construction. There will be an increase in tower heights that will generally be noticeable to the public. The ROW has a rank of medium for forest cover, which will limit the change in the visual character when the ROW is cleared of tall growing species. Limited change in visual contrast with features identified in SASS Report.
- High - Scenarios that will require new ROW, expansion or widening of existing transmission ROW. The number of residences near the ROW is high and a large number of visual resources of state or federal concern have been identified by the Applicants as having potential visibility. Increase in visual contrast for resources of statewide concern, including SASS or properties with documented scenic qualities. ROW with rank of high for existing forest cover, which

will result in a possibly large change in the visual character when the ROW is cleared of tall growing species.

Project Evaluation

Trial Staff evaluated environmental factors for each of the 22 scenarios proposed by the Applicants. Table 1 provides a comparative summary of the several major environmental factors for each of the transmission scenarios.

Trial Staff's environmental ranking of the projects was a multiple step process that combined the quantified, or measured, characteristics of each scenario with the qualitative environmental impact assessment performed by Trial Staff. Each of the quantified characteristics, such as number of streams or federal (NWI) wetlands located in a ROW, miles of ROW, area of forests, forested wetlands, numbers of structures within 250 feet of residences, or State or National Register of Historic Places sites within one mile of the ROW were assigned rankings of low, medium, and high. The parameter rankings were established by calculating the average (mean) for each measurable factor. The medium rank ranges represent one-half of a population standard deviation on either side of the calculated mean. Low rankings were assigned to values less than the medium rank range and high rankings were assigned to values greater than the medium rank range. Table 2, "Comparative Ranking Criteria," identifies the ratings scales applied for each parameter.

Qualitative ratings of visual, sound and river corridor impacts were prepared to have a consistent approach to these parameters. The sound evaluation relies on multiple quantified parameters to create the rating. Definitions for the visual and river corridor ratings were prepared based on the common project attributes such as in-kind replacement or reconductoring, and the location of the scenario.

Following the completion of the quantitative environmental parameters ratings, Trial Staff completed an overall rating for each scenario. The overall rating is qualitative since there are many unknowns in the projects that cannot be quantified. For any given scenario, it is unknown to what extent a quantified resource will be affected by construction practices and facility operation. The resource information identifies the streams and NWI wetlands located within the ROW, however, without extensive detailed information; it is unknown whether the existing access road system crosses these resources or if the road system is in a serviceable condition. The overall rating is not a numerical score but is a qualitative assessment of the anticipated outcome of transmission facility construction in a selected ROW. Trial Staff generally assumed that a scenario in a ROW that is longer with more forest or other resources would require more work near or within those resource areas. A low rating is assigned to a reconductoring project that is short and crosses limited amounts of forests, wetlands or other measured environmental characteristics. Scenarios in a ROW that are outside of a SASS, have a low number of state and national register listed sites within one mile, or do not require significant clearing of forestland, are ranked as low or medium. A reconductoring project of similar length may have a medium rating if the quantified parameters show that there are more resources located in or near the ROW. Projects with high ratings are long projects and many of the high rated projects have new ROW or expanded ROW. Frequently, length related parameters would drive a ranking. In most situations, projects proposed in same ROW with a similar or equal length will have the same qualitative rating. These rankings are intended for comparative evaluation only.

Scenarios with an overall ranking of "low" are anticipated to be most environmentally compatible, whereas project scenarios with an overall environmental ranking of "high" are anticipated to be the least environmentally compatible. Trial Staff advises that even "low" ranking may still represent significant impacts that will warrant mitigation to ultimately support a finding that the impacts have been minimized to the maximum extent practicable.

Applicants submitted information for inventories of rare, threatened, and endangered (RTE) species that may be found near the selected ROW. However, much of this information is provided on a countywide basis; therefore, projects occurring within the same county should have a similar list. At this time, the general regional RTE species data does not create significant differences between many of the projects. Therefore, Trial Staff did not include RTE species data in Table 1. It is routine during the Article VII process to identify measures to protect RTE species by limiting work during seasons when the RTE species are not active or to limit construction in certain areas. Trial Staff assumes that these practices would be required for any project approved for construction in this proceeding.

Noise Impacts

In summary, scenarios 10, 12, 14, 16, 17, and 18 are expected to result in a relatively greater environmental noise impact because either they have a higher number of residences proximal to the ROW, a higher number of acres requiring trees clearing, a higher mileage of wiring, a higher mileage that requires construction of new structures, a greater number of substations to be built or upgraded, or a higher number of substations with relevant noise sources.

Scenarios 6-9, 13, 19a, 19b, and 21 are expected to result in a relatively lower environmental noise impact because either they have a lower number of residences proximal to the ROW, fewer acres requiring tree clearing, a lower mileage of wiring, a lower mileage that requires construction of new structures, a lower number of substations to be built or upgraded, or a lower number of substations with relevant noise sources.

Scenarios 1-5, 11, 15, 19, and 20 are expected to result in a relatively moderate environmental noise impact because the values of the rating variables, as described above, fall in-between the "high" and "low" category ranges.

Coastal Zones, Scenic Areas of Statewide Significance, and Local Waterfront Revitalization Program Considerations

Most of the 22 proposed transmission scenarios involve facilities that would be located in areas within the designated Coastal Area boundary established by the Waterfront Revitalization and Coastal Resources Act, and subject to New York State Executive Law Article 42. This section addresses potential significant visual and natural resource impacts of the range of project scenarios that are proposed to be located within or are likely to have visual effects on designated coastal zone areas including SASS and adopted LWRP. SASS are predominantly located within the lower Hudson Valley region, and were identified and adopted in a publication by the New York State Department of State in July 1993. LWRP documents have been adopted in many municipalities located within the Coastal Area boundary, or in designated Inland Waterways. Four designated SASS areas (with multiple sub-units within the SASS) and three municipal LWRP areas are traversed by one or more of the individual proposed scenarios.

Schodack & Castleton LWRP & Columbia-Greene North SASS Area

Proposals by North America Transmission and NextEra cross the Hudson River coastal zone area including areas within the Town of Schodack. The Schodack coastal zone area is included entirely within the limits of the Local Waterfront Revitalization Plan adopted by the Town of Schodack and the NYS Department of State.

The proposed crossing by NAT at the New-Scotland to Leeds Alternative 2 (Scenarios 2 & 4 for this analysis) from Coeymans to Schodack is co-located adjacent to the CSX Railroad bridge spanning the Hudson River, located south of the Thruway Berkshire Spur Bridge crossing, and immediately north of the existing National Grid New Scotland-Alps 345 kV electric transmission line.

NextEra revised its Hudson River crossing proposal (Scenario 17) to include use of existing National Grid transmission structures at the river span for the rebuild of the New Scotland – Alps 345-kV facility. Trial Staff notes that structure bases are located within the Hudson River. NextEra also proposes to install an underground circuit for a second 345 kV crossing for the Princetown to Knickerbocker line. As an alternative, NextEra proposes to attach the circuit in conduits to the CSX railroad bridge.

Both the NAT and the NextEra overhead lines would be located outside of but visible from locations within the Columbia-Greene North Scenic Area of Statewide Significance, including sub-units CGN-1 (Coeymans Hamlet Waterfront), CGN-4 (Islands) and CGN-13 (Schodack Landing). Potential views would be from both upland areas such as Schodack Island State Park, and areas within the Hudson River. Open views to the north from these areas are already influenced by the existing transportation bridges and utility line crossing of the Hudson River, providing focal points from some locations. Underground crossing, or re-use of the existing National Grid transmission structures, as proposed by NextEra (Scenario 17), would have relatively little change in the existing views, and have little visual impact. Additional structures and conductors, with associated clearing, as proposed by NAT (Scenarios 2 and 4) would likely result in an increase in clutter within the views to the bridges, particularly from SASS open water locations on the river.

Columbia-Greene North SASS Area – CGN-14 Stuyvesant Farms Sub-unit

The Stuyvesant Farms sub-unit is located in an upland area within the Town of Stuyvesant, Columbia County, and east of the bluffs lining the Hudson River. It is comprised of rolling hills, small ravines, open agricultural lands and forestlands. The existing Greenbush-Churchtown National Grid 115-kV overhead transmission line crosses through the sub-unit for nearly two miles, however the open structure and limited height of the lattice steel structures, which are similar to the height of adjoining mature forest trees for most of the length of the sub-unit crossing, limit its visibility and contrast in the landscape. The description of Sub-Unit CGN-14 in the SASS program book does not acknowledge the transmission line specifically, noting only that "no obvious discordant elements exist to distract from the pastoral landscape which is reflective of a working agricultural community" (DOS, SASS, 1993, pg. 53). The area is noted as exhibiting "an unusual variety of major components including highly diverse topography and vegetation… [this] pastoral agricultural landscape is a unique example of the traditional rural heritage” (DOS, SASS, p. 54).

Several of the proposed projects (Scenarios 4, 5, 6, 10, 11, 16, 17, 18, 19 and 19a) involve changes to the existing transmission facilities traversing SASS sub-unit CGN-14. The NAT proposals (Scenarios 4 and 5) involve replacing the existing National Grid double-circuit 115-kV lattice towers with an unusual design -- a heavier steel three-circuit structure-- supporting three 345 kV conductors in a horizontal arrangement above two 115 kV circuits in suspended trefoil arrangements. The height of replacement structures should not increase significantly, however the unusual design, the heavier upright and crosswise support elements and increase in number of wires and insulators may increase facility visibility and contrast from fore-ground viewing locations.

The NYTO proposals (Scenarios 6, 10 and 11) involve replacement of the lattice steel double circuit 115 kV structures with a line of double circuit monopole structures supporting both 115 kV and 345 kV conductors on opposite sides. These structures will be of a similar height as existing lattice structures, but have longer cross-arms to support the higher voltage circuit. The heavier monopole and uneven cross-arm lengths may increase contrast with existing landscape elements from foreground viewing locations.

The NextEra proposals (Scenarios 16, 17, 18 and 19) involve replacement of lattice steel 115 kV structures with double circuit monopoles supporting both 115 kV and 345 kV conductors on opposite sides. These monopole structures will be taller than existing structures and involve heavier support elements than the existing lattice towers, and will be more visible in the landscape due to taller heights, thus visual contrasts are likely to increase somewhat, with potential for some adverse visual effect on SASS sub-unit CGN-14.

Catskill-Olana SASS CO-4 Catskill Creek Subunit

NAT New Scotland-Leeds PV Alternative 1 (Scenario 2) – the proposed alignment is at the eastern side of NYS Thruway (Thruway) – I-87- across Catskill Creek. As viewed from northbound lane of the Thruway, the overhead line would result in tree clearing on hills to east of the Thruway, tall structures to span Catskill Creek gorge, and a line of monopole transmission structures at alignment to north. Passengers in northbound cars have limited opportunity for views of Catskill Creek itself due to oblique angle of stream alignment in relation to the Thruway.

But the subsequent northerly view would be of tall transmission lines at ridgeline at approximate ground-level elevation of 200 feet. While this location does not specifically conflict with views to the waters of Catskill Creek – arguably the most significant aspect of this coastal zone scenic resource area - there would be significant contrast with the wooded banks of the Creek. The SASS characterization of the site describes “large utility lines” as discordant features considering the variety of landforms within the creek corridor. Addition of more overhead utility transmission lines will increase the number of discordant features within the CO-4 sub-unit. Furthermore, the number of viewers – primarily Thruway travelers - and extent of views of discordant features will increase significantly by the addition of overhead lines within this landscape.

Southbound travelers on the Thruway are exposed to a more dramatic vista than are northbound viewers at the crossing of Sub-Unit CO-4. The vista includes a southwesterly view of

Catskill Creek including "the winding creek, the flood plains and the steep banks" within "the wilderness character" of the creek ravine, toward the source of this stream within the higher terrain of the Catskill Mountains (SASS Report, NYS DOS, 1993). The location of the proposed NAT transmission facility (Scenario 2) at the eastern side of the highway would cross the crest of the steep wooded creek ravine. A cleared corridor for the overhead line would be introduced, with a row of tall transmission towers trailing into the middle-ground distance. As noted above, the nature of the change of the NAT scenarios is the introduction of additional discordant features within and highly visible from SASS sub-unit CO-4, with high degrees of visibility for a large number of viewers.

NextEra Option #1 (Scenario 15) proposes a tall monopole facility in alignment at the western side of the Thruway. This scenario would result in overhead line installation at or near high points north and south above the Catskill Creek corridor. Southbound views, as described above, would be significantly compromised by the addition of tall electric transmission structures and multiple conductor wires, cleared forest for facility right-of-way, and any associated access route. The steep slope at south side of Catskill Creek has bedrock near ground surface, indicative of conditions that would entail rock excavation and cut rock faces for an access road to structure locations.

North-bound travelers along the Thruway would have views to the proposed NextEra transmission facility at the western side of the Thruway at the crest of the steep wooded creek ravine, extending well above the tree line. A cleared corridor for the overhead line would be introduced, with a row of tall transmission towers trailing into the middle-ground distance. The nature of these potential changes would be the introduction of additional discordant features within Sub-Unit CO-4, highly visible to a large number of viewers.

Village of Athens LWRP, and Catskill-Olana SASS area (Scenarios 1, 3, 7, 9, 12, 14, 20)

The Village of Athens LWRP spans the length of Hudson River waterfront within the Village. The LWRP acknowledges the existing National Grid transmission lines crossing the Hudson River at the southerly portion of the Village as "unattractive visual elements…in the Coastal Zone" (Athens LWRP, 2002, pg. II-10). Several scenarios including proposals by NAT, and the NYTOs, would utilize the existing National Grid transmission corridor. The existing corridor includes three overhead transmission lines on tall steel lattice structures aligned in parallel, with some structure bases located within the Hudson River. Trial Staff notes that the existing Iroquois Gas Transmission line is also located a short distance northerly of and parallel to the National Grid transmission corridor. Important viewpoints to the corridor from within the LWRP area include the Athens Light House historic property within the river, the Lower Village Historic District, and the Veterans Memorial Park at South Franklin Street.

Figure 16: Existing View Easterly at Hudson River Utility Crossing, Athens NY

The existing ROW of transmission lines approaching and crossing the Hudson River is also located outside of, but is visible from locations within sub-units of the Catskill-Olana SASS area, including CO-1 Catskill Bluffs Sub-unit, CO-5 Rogers Island Sub-unit, and CO-6 Olana Sub-unit. The Rip Van Winkle Bridge traverses the Hudson River at the location of CO-1 and CO-6. The Bridge is the main visual element of many views in this area, providing a stark contrast to natural elements, while also providing one of the most important viewpoints within these areas, as vehicles passing on the Bridge high above the River gain sweeping views of the River, shorelines, forested bluffs and wetlands, as well as temporal elements including ships and boats on the River and wildlife. The Bridge conveys NYS Route 22 across the River, and is a designated Scenic Road.

In Scenarios 1 and 3, NAT proposes to install an additional 345 kV line on tall steel lattice towers adjacent to the three existing transmission facilities (as depicted in NAT

Part A filing, Attachment 2, Figure C-3, March 2, 2015). NAT was the only project proponent that actually simulated a view of the proposed Hudson River crossing. The proposed fourth set of transmission towers would add visual clutter and additional aviation warning lighting to the existing scene, further compromising views from historic locations and recreational sites. An added line of transmission towers would likely be visible from the Rip Van Winkle Bridge, as well as from the SASS sub-units cited above.

The proposals by NYTO for scenarios 7, 9, 12, and 14, 20, would involve either reconductoring of existing circuits (#7, 12 and 20) or replacement of old lines on lattice structures with new circuits on monopole structures (#14). Reconductoring existing lines on existing structures would result in little if any visual change from the existing scene, although the developers indicate that some number of existing structures may need to be replaced depending on conditions and detailed engineering analysis. Visibility and contrast will depend in large part on the final design and height of replacement structures. Replacement of steel lattice towers with monopoles may increase overall visibility and visual contrast with remaining steel lattice towers on adjacent circuits. Mitigation strategies for minimizing specific impacts on SASS areas and individual sub-units will be important considerations in any Part B evaluations undertaken by the Commission.

Visibility from SASS Sub-Unit CO-6 Olana (State Historic Site) is expected to be limited to vantage points located off of the carriage trails, but not from the hill-top mansion or from most open areas on the property. Northwesterly views to the transmission corridor’s western approach to the Hudson River over 2.5 miles away are available from spot locations at steep ledges located off the Ridge Road carriage trail. Northeasterly views to the transmission corridor south of the Hudson River crossing are afforded from locations in the recently restored north meadow along the Ridge Road carriage trail. The tops of existing lattice transmission towers are visible in some lighting conditions. Reconductoring proposals should not result in any increase in visibility, although use of non-specular conductors that minimize reflectance from the metallic conductor surfaces may be an important mitigation measure for consideration in final project design.

The Hudson River crossing at the Village of Athens also warrants consideration of wetlands and habitat impacts. Proposals involving construction of new facilities, replacement of existing facilities, and reconductoring of facilities in this ROW will all have some degree of disturbance to wetland and wetland habitat, with specific impacts dependent on the nature and extent of disturbance, timing and duration of construction activities, and site controls and mitigation measures associated with construction and restoration of sites. Any project(s) selected by the Commission to proceed to the Part B Application phase will need to identify specific extent of work and details of construction and mitigation to address specific impact minimization strategies, plans and procedures.

Town of Lloyd LWRP, Esopus-Lloyd SASS, and Estates District SASS (Scenarios 2 and 15)

The two proposals to utilize Thruway ROW near New Paltz, Ulster County, and precede easterly to Pleasant Valley Substation, involve crossings of the designated Hudson River coastal zone area including the area within the Town of Lloyd, Ulster County that is within the Town LWRP. The proposal by NAT - Alternative 2 - (Scenario 2) would traverse forested bluffs and slopes within the Esopus Lloyd SASS Sub-Unit EL-4 (Lloyd

Bluffs); as well as the open water of the river, included in Sub-unit EL-4 (as well as within Estates District SASS Sub-unit ED-27, the estate and landscape associated with the Franklin D. Roosevelt Home National Historic Site located east of the river in the Town of Hyde Park, Dutchess County).
Clearing of forest and installation of a major transmission facility at Sub-Unit EL-4 is likely to adversely affect views from the Sub-Unit, as well as views from the nationally significant Franklin Delano Roosevelt (FDR) Historic Site in ED-27 westerly to sub-unit EL-4. The Lloyd LWRP acknowledges that "clearing and grading would alter the existing natural state and visual quality of the bluff line…Construction on or near the bluff would alter the visual quality by introducing protruding structures, such as…utility lines in the existing landscape" (Lloyd LWRP, pg. II-32). The LWRP also recommends protection and preservation of the wooded bluffs along the Hudson River due to habitat for threatened bird species (Lloyd LWRP, Policy 7B, pg. III-8).

Development of a new utility corridor across the Hudson River at this location, as proposed by NAT, would not constitute orderly development, given that existing underground utility corridors and river crossings are located in the area of the Mid-Hudson Bridge and the historic Railroad Bridge, now a State Park designated the "Walkway Over the Hudson" a short distance southerly of the NAT proposal.

The proposed crossing by NextEra would be sited in relation to the Mid-Hudson Bridge. Clearing of forest or grading to accommodate the transmission facilities along the wooded slopes, and installation of overhead transmission lines or underground lines within SASS sub-unit EL-4 would potentially adversely affect the natural state and visual quality of the area. NextEra suggests consideration of alternative utilizing conduit attachments to the historic Railroad Bridge: this would warrant development of detailed engineering and consideration of compatibility with the National Register of Historic Places criteria for alteration of the historic structure, as well as the recreational use of the Walkway over the Hudson.

Boundless Hudson River Crossing – Town of Newburgh to Town of Wappinger (Scenarios 20, 21)

Boundless proposes to install underground/under-water Hudson River crossing with cables installed by HDD. The crossing location from Town of Newburgh, Orange County, to Town of Wappinger, Dutchess County, is outside of any LWRP areas or SASS designations, and will essentially not be visible due to underground installation. Clearing of forest for a ROW and any marker signs posted to warn ships as to the underground line location would be the only potential visual changes related to underground installation of transmission line cables. The crossing location proposal coincides with existing utility and other intensive shoreline uses, so the probable changes due to underground installation would be minimal. Boundless projects (Scenarios 20 and 21) would not adversely affect any SASS areas or LWRP.

Post Interim Report Comments & Letters Filed by Scenic Hudson

Columbia-Greene North SASS Visibility

The Interim Report addressed project visibility from the Columbia-Greene North Scenic Area of Statewide Significance (SASS) area in sub-units CGN-1, CGN-4, CGN-13, and CGN-14 (DPS Interim Report pp. 76-79). The Report acknowledges visibility from the sub-units whether the proposed facility locations were within or outside of the SASS areas. Views to the proposed Hudson River crossing were identified and visual affect characterized for underground installation, bridge attachment, replacement of conductors on existing overhead transmission facilities (reconductoring), and new overhead placements (Trial Staff Interim Report, p. 77).

In the July 21, 2015 Technical Conference presentation, Scenic Hudson consultant Richard Smardon took minor issue with Trial Staff Interim Report assessment regarding facilities proposed for the segment of the Greenbush-Churchtown segment of the National Grid ROW that crosses directly through the Stuyvesant Farms SASS sub-unit CGN-14. In the Report, the existing landscape is described, the characterization of the landscape description in the SASS report is summarized, and the nature of changes that may occur from installation of new facilities proposed to replace existing facilities is described. As the Trial Staff Interim Report acknowledges, the existing overhead double-circuit 115 kV electric transmission facility is not even identified as a visual element in the NYS Dept. of State SASS sub-unit description. The existing National Grid ROW is located in areas adjoining forestland for over 80 percent of the length its the distance across the sub-unit, so visibility of facilities is generally limited from areas away from the ROW, as described in the Repot. Trial Staff identifies foreground-viewing positions as potentially experiencing increased visibility and contrast from new structures as compared with existing facilities for the NAT and NYTO proposals.

The Interim Report identified probable increased visibility in the surrounding landscape due to taller replacement structures, potentially resulting in some adverse effects on SASS sub-unit CGN-14. Viewshed analysis, such as that provided by NYTOs for the Knickerbocker-Pleasant Valley corridor, indicates the limited areas of expected change in visibility from increased structure heights as compared to existing structure heights, considering the screening effects of forest cover (NYTOs Part A, Figure 1.4-3, Map 1 of 7; March 2, 2015). NextEra provided viewshed mapping showing areas of expected visibility of taller replacement structures, but did not distinguish the net change in transmission structures visibility from existing conditions (NextEra Part A, Marcy-Southern Route, Figure A-9; March 2, 2015).

The Trial Staff Final Report rankings for proposed projects within the Columbia-Greene SASS area, and the CGN-14 sub-unit in particular, were generally the same or higher than the Scenic Hudson rankings for the same facilities.

Taller Structures Near Olana State Historic Site

In the July 21 Technical Conference presentation, Scenic Hudson consultant Richard Smardon took minor issue with the Trial Staff Interim Report assessment regarding views from the Catskill-Olana SASS, and sub-unit CO-6 in particular, to potentially taller facilities proposed for some of the proposed transmission upgrades. The Trial Staff Interim Report identified the same vistas from the Olana Historic Site within SASS CO-6 that were reported by Dr. Smardon, and noted that

> "visibility and contrast will depend in large part on the final design and height of replacement structures. Replacement of steel lattice towers with monopoles may increase overall visibility and visual contrast with remaining steel lattice towers on adjacent circuits" (Trial Staff Interim Report, pg. 83).

The Interim Report thus recognized that significantly taller structures located at prominent landscape positions could be more visible from some locations. Development of detailed analysis of visual contrast requires additional levels of information than have been provided in the Part A filings, which were intended to be used as an initial screening tool for identifying relative levels of impacts based on preliminary location and design concepts. The information provided in the Part A filings enabled Trial Staff and Scenic Hudson to come to initial determinations of relative levels of anticipated impacts – determinations that generally are more similar than disparate. Trial Staff agrees that the Olana State Historic Site and views from the site within SASS sub-unit CO-6 are important considerations in rating the various transmission project proposals. This visual receptor will certainly be a focal point for detailed assessment of any projects that are selected to be further assessed in Part B applications at later stages of the AC Transmission comparative proceeding.

Trial Staff identified a specific mitigation strategy for reconductoring proposals involving use of non-specular conductors to minimize reflection of direct sunlight. Scenic Hudson's consultant is correct that structure heights will be important considerations in assessing impact at key visual receptors, and in development of mitigation strategies to minimize, to the extent practicable, adverse effects on those receptors and landscapes in general. The Trial Staff Interim Report indicated that

> "any project(s) selected by the Commission to proceed to the Part B Application phase will need to identify specific extent of work and details of construction and mitigation to address specific impact minimization strategies, plans and procedures" (pg. 84).

New Support Structures & Omega Institute

The Scenic Hudson presentation suggested that the Trial Staff Interim Report did not take into account the potential for visibility of structures from outdoor event areas at the grounds of the Omega Institute for Holistic Studies, which is located in Town of Clinton in Dutchess County. (Omega Institute properties located in the City of Poughkeepsie are not considered in this description.) While the Omega Institute can be considered a cultural destination of some note, it is not necessarily a visual resource in the sense that it is not a property that would be classified as having statewide or national status as a scenic resource, such as under the NYS DEC Visual Policy.

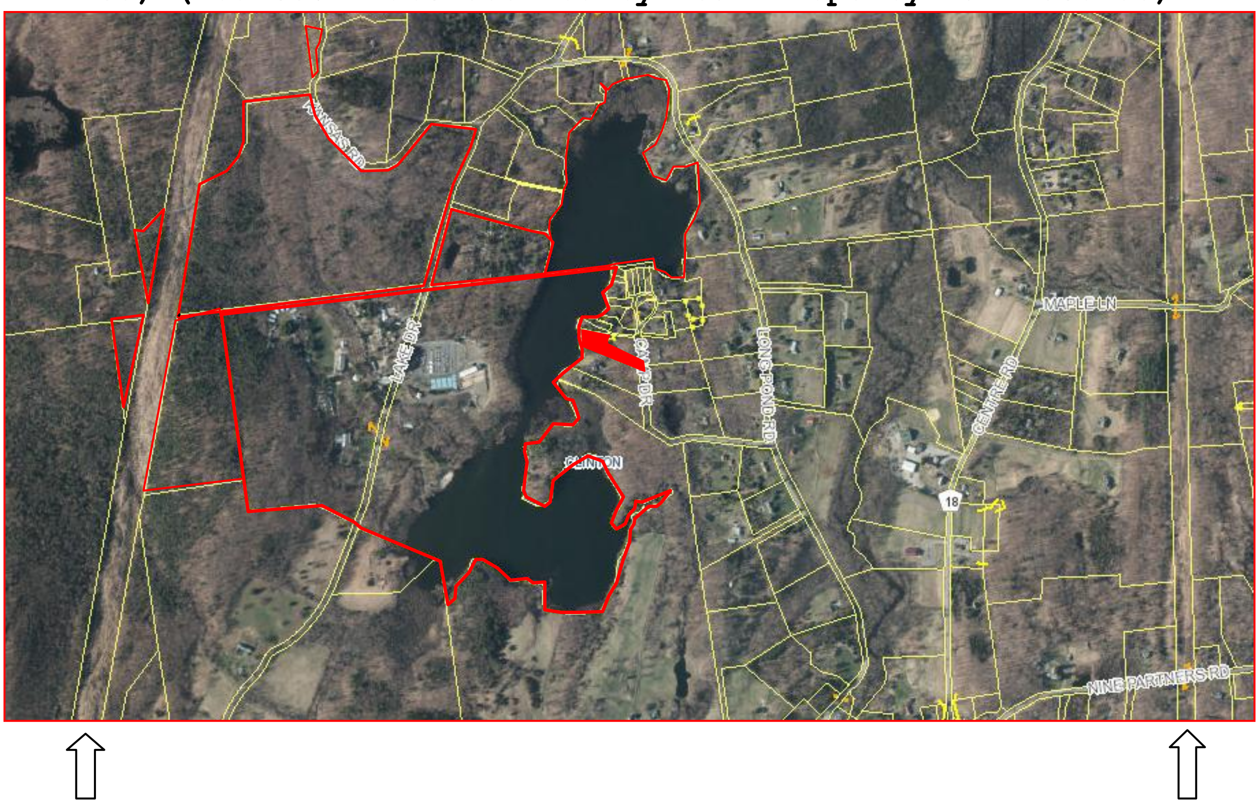
Regardless of this distinction, the area of the properties comprising the Omega Institute campus are included in the viewshed analyses provided by the three principal proponents of projects in the vicinity. NAT, NextEra, and the NYTOs provided viewshed mapping for the various transmission scenarios located along two existing National Grid ROWs, which are located at the westerly edge of the Omega Institute main campus property on Lake Drive, and approximately one-mile easterly of the campus. (Boundless scenario 21 would also involve reconductoring of existing facilities, but no separate visual assessment was provided for this proposal.) The area around the Omega Institute campus is depicted in attached Figure A, with highlights indicating tax parcels reportedly owned by Omega.

Trial Staff notes that the viewshed analyses provided by project proponents indicates areas of expected visibility of proposed transmission structures in the area of the Omega campus. For example NextEra provided viewshed figures depicting numbers of structures visible, assuming tree heights in forest lands are 40 feet tall (NextEra Part A, Appendix A; Marcy Southern Route – Greenbush to Pleasant Valley Segment, Figure A-13; March 2, 2015). Likewise, the NYTO viewshed analysis indicates the expected change in areas of visibility from increased structure heights as compared to existing structure heights (NYTO Part A: Knickerbocker-Pleasant Valley, Figure 1.4-1, Map 6 of 7; March 2, 2015).

As noted above, Scenic Hudson's consultant is correct that structure heights will be important considerations in assessing impact at key visual receptors, and in development of mitigation strategies to minimize, to the extent practicable, adverse effects on those receptors and landscapes in general. The Trial Staff Interim Report indicated that

> "any project(s) selected by the Commission to proceed to the Part B Application phase will need to identify specific extent of work and details of construction and mitigation to address specific impact minimization strategies, plans and procedures" (pg. 84).

Figure 17: Tax Parcels at Omega Institute Campus (Outlined in Red) (Source: Dutchess County Real Property Tax Records)



National Grid ROW

Scenarios 1,3,7,12,20

National Grid ROW

Scenarios 4,5,6,9,10,11,14,15,16,17,19a,20

Further Scenic Hudson Recommendations

The Visual Presentation by Dr. Smardon for Scenic Hudson and the Hudson Valley Coalition suggested that Scenic Hudson would like to see:

- Comparative visual analysis/simulations;
- Visual mitigation analysis; and
- Cumulative landscape impacts assessment.

The Part A assessments provided a level of information that was appropriate for making initial screening analysis among competing proposals. Indeed, based on the applications of four project developers, both Trial Staff and Scenic Hudson were individually able to provide relative rankings of environmental and visual impacts, and made recommendations for over 20 scenarios based on the analysis provided by the four developers.

The additional analyses recommended by Scenic Hudson are more advanced levels of information that Trial Staff has anticipated would be provided, based on additional site information and engineering details, in Part B filings for projects that remain active after the initial decisions on Part A results. To date, only the NYTOs have accurate horizontal and vertical positions and heights of specific existing transmission towers to create the detailed zones of visibility and photo simulations, including for critical visual locations; therefore looking at specific locations in greater detail is beyond the accuracy of the available information for the other applicants.

The Part B submittals will be for a limited set of specific projects, and consideration of mitigation issues such as alternative tower types, heights and colors, details of large river crossings, and alternative configurations will be considered, rather than multiple projects on a range of locations that are currently being discussed in the broad scale

Part A screening assessment. Trial Staff would welcome any specific scoping comments for Part B submittals that Scenic Hudson would like to provide.

Additional Information

The Scenic Hudson report "*Landscape Analysis for Competing Proposals*" by Dr. Richard Smardon indicates that the Boundless Leeds to Hurley Avenue Corridor scenario crosses sub-units HH-26 and HH-27 within the Hudson Highlands Scenic Area of Statewide Significance (*Landscape Analysis*, pp. 11-14). Close review of the Boundless proposal to cross the Hudson River from the Roseton substation to the East Fishkill substation indicates that the river crossing location is from the northern part of the Town of Newburgh, in Orange County north of the City of Newburgh, to the Town of Wappinger, north of the City of Beacon in Dutchess County. The crossing location and upland route of the proposed underground 345 kV cables is north of the mapped Hudson Highland SASS area, being some three miles distant from the northern extremity of SASS sub-unit HH-26. The proposed underground location of the Boundless transmission cables would not be visible from or have any effect on the Hudson Highlands SASS area or its sub-units.

Environmental Rankings

The following summary of the scenarios identifies the major factors for ranking the relative environmental impact of each of the transmission facilities scenarios. This description does not re-create the full range of information considered in reaching the rankings as reflected in Table 1, but is rather illustrative of the major drivers of each scenario's ranking.

Scenario 1 was assigned an overall environmental ranking of high. The primary factors for this ranking were the potential visual impacts of the overhead facilities on the Erie Canalway National Heritage Corridor and the Hudson River corridor and the high amount of new ROW that would be required as compared to other proposals in this proceeding. Projects requiring new ROW are anticipated to require large amounts of new property acquisition, impacts to agricultural land uses and new land clearing through previously undisturbed wetlands, forests, wildlife habitats and other environmentally sensitive areas.

Scenario 2 was assigned an overall environmental ranking of high. The primary factors for this ranking were the high amount of new ROW and associated land clearing that would be required as compared to other proposals in this proceeding, incompatibility of the proposed facility with existing land uses and potential visual impacts of the overhead facilities on the I-87 Thruway corridor, Erie Canalway National Heritage Corridor, Hudson River corridor and the Franklin D. and Eleanor Roosevelt National Historic Sites.

Scenario 3 was assigned an overall environmental ranking of high. The primary factors for this ranking were those identified in the discussion of the overall environmental ranking of Scenario 1. Because NAT did not provide details regarding the MA-CC loop, this component was not included in Trial Staff’s overall environmental assessment of Scenario 3.

Scenario 4 was assigned an overall environmental ranking of high. The primary factors for this ranking were potential visual impacts of the overhead facilities on the Erie Canalway National Heritage Corridor and the Hudson River corridor, the high amount of new ROW and associated land clearing that would be required for the ED-FR component and the new ROW that would be required for the NS-PV Alt 2 component where it will parallel the existing CSX railroad ROW. Additionally, although the proposed structures will be no greater in height than the existing structures on the GB-CH and CH-PV ROW, the proposed multi-circuit horizontal H-frame structures will have a more visually dense arrangement than existing towers and therefore may result in an increase in the visible contrast to the existing landscape.

Scenario 5 was assigned an overall environmental ranking of high. The primary factors for this ranking were those identified in the discussion of the overall environmental ranking of Scenario 4.

Scenario 6 was assigned an overall environmental ranking of low. The primary factors for this ranking were its relatively short length, use of existing ROW and replacement of existing lattice tower structures with fewer, monopole structures.

Scenario 7 was assigned an overall environmental ranking of low. The primary factors for this ranking were the relatively short length of the route and the limited amount of environmental impacts anticipated from reconductoring construction activities within an existing ROW.

Scenario 8 was assigned an overall environmental ranking of low due to construction impacts confined to an existing substation and no transmission facility construction.

Scenario 9 was assigned an overall environmental ranking of low. The primary factors for this ranking were the relatively short length, the limited amount of environmental impacts anticipated from reconductoring construction activities within an existing ROW and replacement of existing structures with fewer, new structures. The proposed facilities may result in some increase in visual contrast due to the change in structure type; however, they should also reduce agricultural land impacts.

Scenario 10 was assigned an overall environmental ranking of high. The primary factors for this ranking were the need to clear hundreds of acres of forested wetlands and upland areas within the existing O-FR ROW, the increase in height and change in design of the existing O-FR transmission facility, which result in a design contrast between the old and new lines and the long total length of this scenario.

Scenario 11 was assigned an overall environmental ranking of medium. The primary factors for this ranking were the construction in an existing ROW that limits environmental construction impacts, and the possibilities of reducing the number of structures within an existing ROW. New structures will be sited in more suitable locations (outside of wetlands) resulting in reduced environmental impacts.

Scenario 12 was assigned an overall environmental ranking of medium. The primary factors for this ranking were the construction in an existing ROW that limits the associated environmental construction impacts, and the possibilities of reducing the number of structures within an existing ROW and siting structures in more suitable locations with less severe environmental impacts.

Scenario 13 was assigned an overall environmental ranking of medium. The primary factors for this ranking were the relatively moderate length and associated environmental construction impacts, and the possibilities of reducing the number of structures within an existing ROW and siting structures in more suitable locations with less severe environmental impacts.

Scenario 14 was assigned an overall environmental ranking of medium. The primary factors for this ranking were the construction in an existing ROW that limits the associated environmental construction impacts, and the possibilities of reducing the number of structures within an existing ROW and siting structures in more suitable locations with less severe environmental impacts.

Scenario 15 was assigned an overall environmental ranking of high. The primary factors for a high ranking were the clearing of expanded areas of ROW and changes in the visual character of the Thruway corridor, potentially affecting numerous travelers and residences, and the estimated distance of 21.1 miles in floodplains.

Scenario 16 was assigned an overall environmental ranking of medium. The primary factors for this ranking are the construction in existing ROW, low amount of forest wetland clearing, NWI wetland and floodplain crossings. This scenario is proposed for the same ROW as NYTO 11 and 12.

Scenario 17 was assigned an overall environmental ranking of high. The primary factors for this ranking were the cumulative length of the components, and potential for forest or forested wetland clearing, number of residences and the proposed new substations. Scenario 17 is similar to Scenario 11 and 12 by NYTO, which are rated as medium. Scenario 11 and 12 by NYTO have a common segment between Marcy and New Scotland, however, Scenario 17 includes a rebuild of an existing overhead Hudson River crossing and a second Hudson River crossing by either bridge attachment or HDD.

Scenario 18 was assigned an overall environmental ranking of high. The primary factors for this ranking were the construction of new ROW that will disturb forested and agricultural lands, potential visual impacts of the overhead facilities on the Erie Canalway National Heritage Corridor, the high number of residences in close proximity to the ROW and the construction of the new Oak Hill substation facility.

Scenario 19, as originally included in the Trial Staff Report, was assigned an overall environmental ranking of medium. The primary factors for this ranking were the relatively short length of the facilities, the number of streams in the ROW and length of NWI wetlands crossed by the selected routes. Scenario 19 is 8.8 miles longer than the Scenario 6, both ware proposed for same ROW starting at Knickerbocker site (not including the Oakdale-Fraser segment Trial Staff has now excluded from its analysis and made a standalone Project 19b). The longer Scenario 19 route reports lower acres of forested wetlands and forest involvement than the Scenario 6 NYTO proposal. The qualitative assessment for Scenario 19 may have slightly greater resource involvement since it is longer and is therefore rated as a medium rather than low.

Scenario 19a was assigned an overall environmental ranking of low. The primary factors for this ranking were the relatively short length of the facilities and the use of existing ROW for the entire length of the facility and the large numbers of nearby residences. A similar Scenario 6 NYTO is also rated as low.

Scenario 19b was assigned an overall environmental rating of medium. The primary factors for this rating were the relatively short length, construction in an existing ROW, low numbers of streams and NWI wetland crossings in this scenario.

Scenario 20 was assigned an overall environmental ranking of medium. In general, activities proposed as parts of Scenario 20 would typically be considered insignificant. However, there are uncertain factors in the proposal that create potential concerns. First, Trial Staff considers aspects of the proposed activities to be infeasible; chiefly, this is exhibited by the use of helicopters for reconductoring activities. Second, structures along proposed reconductoring segments would likely require replacement during or after Boundless' activities are undertaken. This would create another round of more extensive environmental impacts in the near future. Lastly, the information provided by Boundless has not been sufficiently reliable to support a proper assessment of its project. This uncertainty leads Trial Staff to conclude that there may be additional impacts that have not been identified by the Applicant.

Finally, Scenario 21 was assigned an overall environmental ranking of low, due to the limited amount of reconductoring proposed, new facilities being located underground, and use of HDD for installation of the Hudson River crossing avoiding some visual impacts, but there may be important aquatic, estuary resources at the proposed HDD crossing site.

Innovative Technologies

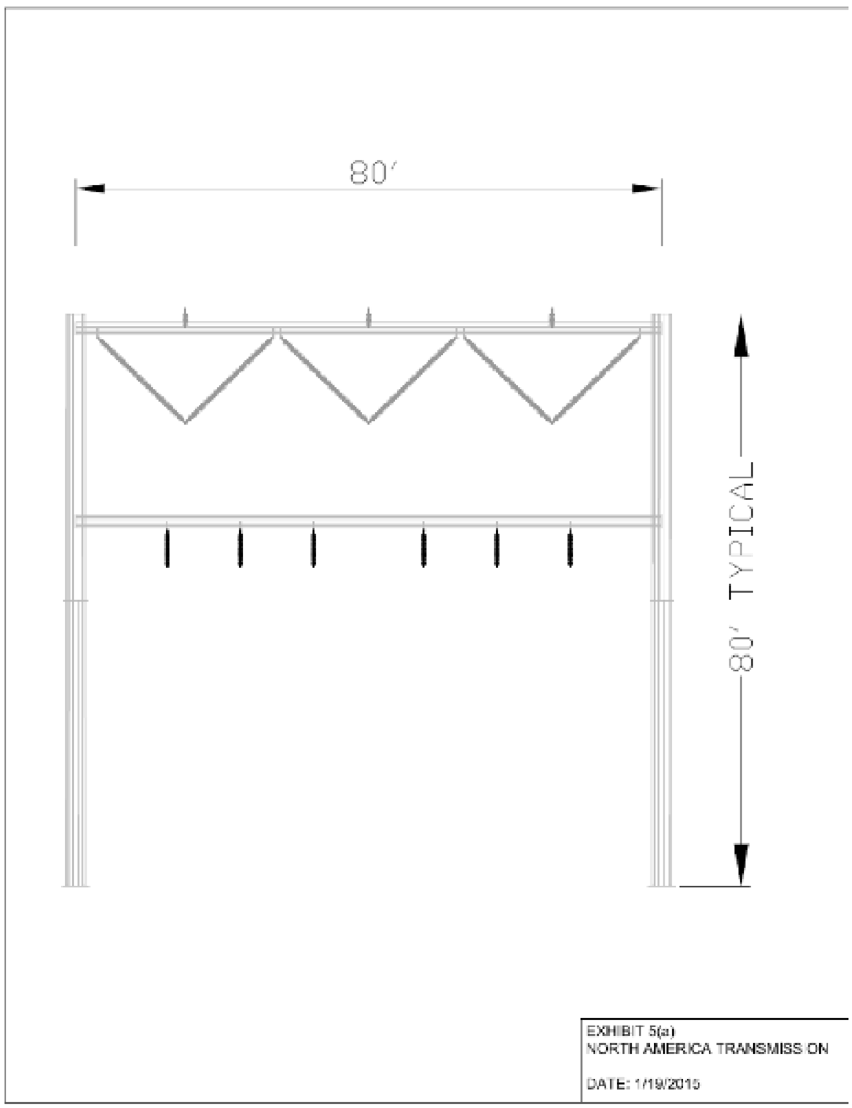
In its December Order the Commission tasked Trial Staff with comparing different projects on the basis of their use of "Innovative Technologies" that would reduce the footprint of a project or increase transfer capabilities. Most of the technologies proposed by the Applicants as innovative are already in use in New York or elsewhere, while some proposals included technology claims that will require further study before the efficacy of the Applicants claims can be verified. The following section is a review of the different innovative technologies proposed by each Applicant.

North American Transmission

North American Transmission proposes to construct towers that would reportedly use 47% less right of way width for 90% of their project length. NAT proposed a triple-circuit tower construction for the Knickerbocker to Pleasant Valley line that would have a 345-kV circuit in a horizontal configuration above two side-by-side 115-kV circuits in horizontal arrangement (see Figure 17 below). This triple-circuit structure presents both visual and engineering concerns. Environmentally the triple-circuit design may be beneficial in that, according to the Applicant, it would not require any expansion of the existing ROW and pole heights will remain consistent with what is currently on the line. The drawback from an environmental standpoint is that the three circuits will be more densely arranged and therefore this may offset some of the visual benefits (i.e., limited height and ROW width). From an engineering perspective, it would be preferable to have a structure design with one side as a 345-kV circuit and the opposite side a two conductor bundled 115-kV facility. This would increase separation between the 345 and 115 kV circuits, enabling maintenance on either facility and reducing potential for a conductor failure to affect multiple circuits. The more compact design would provide for greater separation from the co-located gas pipeline, and occupy less ROW width. Any environmental gains need to be weighed against the engineering concern that if a fault or a lightning strike occurs all circuits on the three-circuit structures will be interrupted.

Figure 18 - North America Transmission Amended Initial (Part A) Application; Book 1, Volume 1, New Scotland to Leeds to Pleasant Valley Component [Alternative 2]; Exhibit 5 Design Drawings, Fig. 5-3; January 20, 2015.

FIGURE 5-3. PRELIMINARY DESIGN DRAWING (ALTERNATIVE 2 115/345-KV STRUCTURE)



Furthermore, as pointed out in the Interim Report, NAT did not take into account the location of an existing National Grid gas transmission line located within portions of the existing Greenbush to Churchtown ROW, and its relation to the proposed facility footprint, so the veracity of claims about the triple-circuit design not requiring clearing or additional ROW cannot be verified.

For the proposed Edic-Fraser facility, NAT also proposed to include the installation of fiber optic shield wires, which presents the opportunity to include broadband internet connection to the communities near the facility. However, absent a service provider the inclusion of this offer to increase broadband to rural communities would be moot.[40]

NAT proposed the use of series compensation as an advanced technology in various locations in its project proposals (Scenarios 1-5). Trial Staff notes that series compensation is not a new technology, and its use has the possibility of creating problems that would have to be resolved in order for it to be incorporated, such as causing sub-synchronous resonance that could damage generator rotors. Additional control equipment would need to be added to mitigate these risks. Use of additional series compensation would also require existing relays in many substations to be changed out to accommodate the project system stabilizers, and other additional equipment not identified or included in the NAT proposal.

[40] Otsego County Conservation Association, Inc. letter [Comments on DPS Interim Report], April 21, 2015, at pg. 3.

Boundless

Boundless Energy proposed as an innovative technology the use of advanced capability composite-core conductors for the reconductoring of existing utility circuits. While the design of the conductor core is new, it does bring some drawbacks. The thermal characteristics of the conductor would allow for a greater load, and thus increase transfer capability; however the higher temperatures on the conductor would increase the line loss and decrease the efficiency of the system. In addition, the existing structures proposed to be reconductored may not meet current codes and standards and thus may require significant structural reinforcement. The potential for these limitations presenting a limitation on Boundless' proposed reconductoring is evidenced by the fact that manufacturers of the conductor warn utilities that some structures will require additional foundation reinforcement for wind loading.[41] The potential extent of this reinforcement work needed on proposed facility upgrades has not been evaluated by Boundless.

NextEra

NextEra has proposed a significant number of what it identifies as "smart" technologies as a part of its proposals. Many of the proposed smart technologies, however, are already in use by the NYTOs in their stations including relay oscillography, remote access fault records, real time weather, lightning strike detection, supervisory control, real time equipment monitoring, fault location, PMU–synchrophaser, GPS time, transformer monitoring, battery monitoring, breaker

[41] See, e.g., Engineering Transmission Lines with High Capacity Low Sag ACCC® Conductors, CTC Global, pp. 97-102, available at http://www.ctcglobal.com/products/learn-more-about-accc-conductor.

condition, etc. This equipment is all currently being used by New York transmission owners and operators.

Additionally, NextEra proposes to build concrete poles. According to the Applicant, these poles simplify the construction process as they don't require the pouring of foundations. At this time, Trial Staff cannot fully address the efficacy of NextEra's claims as to date, no concrete structures of similar size and configuration have been constructed in New York State. Concerns remain both regarding the method of transport for such structures, and the ability to deliver them to remote locations on existing ROW and access roads. Trial Staff must reserve judgment on any such towers until any Part B application comes before the Commission, where additional supporting documentation regarding concrete pole characteristics and performance would be necessary. Trial Staff advises that it may recommend that the Commission require the use of steel poles, which may have a corresponding effect on project cost estimates.

NYTOs

The NYTOs have developed structure designs that increase utilization of existing ROW with compact line construction. They have proposed the use of Aluminum Conductor Stainless Steel (ACSS) core in lieu of Aluminum Conductor Steel Reinforced (ACSR) core conductors to increase power transfer along the ROW. In addition, the NYTOs have proposed using "smart wire" technology to control flows on transmission circuits. The smart wire technology benefits include a reduced footprint at the substation, however this technology may increase the need for future repair and maintenance on the line, including heavy equipment use in the ROW. The NYTOs have also suggested utilizing dynamic load monitoring on overhead circuits.

The structure designs proposed by the NYTOs include monopoles and compact H-frame structures to avoid the need to expand ROW width, and the use of helical foundations for smoother installations and less drilling leading to fewer environmental impacts during construction. The NYTOs also proposed the use of mitigation measures to reduce bird-conductor contacts including diverters.

COMPARATIVE EVALUATION RESULTS & RECOMMENDATIONS

A comparative evaluation of the proposed alternatives is useful for two purposes: (a) to screen out less attractive proposals from further consideration; and (b) to determine if the need for a specific project deemed most attractive can be justified on the basis that its expected overall benefits exceed its expected overall costs.

The initial screening in the Interim Report – based on relative environmental impact and UPNY/SENY transfer capability increase – used the following hierarchal rules: (1) alternatives with a Low environmental ranking and an increase in UPNY/SENY transfer capability were retained for further consideration; (2) alternatives with a Medium environmental ranking, with an increase in the UPNY/SENY transfer capability of 700 MW or greater, were retained for further consideration; (3)alternatives with a Medium environmental ranking with an increase in the UPNY/SENY transfer capability of less than 700 MW, but with a potential for increasing above 700 MW due to the construction of the CPV Valley generating facility, were provisionally retained for further consideration; (4) alternatives that resulted in a decrease in the UPNY/SENY transfer capability were eliminated from further consideration; (5) alternatives with a High environmental ranking were eliminated; and (6) alternatives with a Medium environmental impact and an increase in the UPNY/SENY transfer capability of less than 700 MW were eliminated from further consideration.

Regardless of the initial screening, the monetary benefit-cost ratios (considering present value of both benefits and costs over the proposed project’s expected useful life) were estimated for each of the proposed alternatives. In theory, any alternative which passed the initial environment/transfer capability screening, and which possessed a monetary benefit-cost ratio of greater than 1.0 would be a serious contender for being approved for construction. As a part of the Public Policy analysis the Commission must undertake, the total expected benefits (including monetary benefits, quantified but not monetized benefits, and qualitative benefits) would need to be compared against total expected cost (including monetary costs, quantitative environmental impacts and qualitative environmental impacts). Thus, a proposal would be considered cost effective and deemed needed for public policy purposes if the quantitative and qualitative benefits of the proposal, on balance, are expected to exceed the quantitative and qualitative cost of the proposal – more so that other alternative proposals.

In conducting its final analysis, Trial Staff followed a similar methodology to that used in the Interim Report. The following screens were used to winnow out projects and ultimately reach our recommendation. First, projects with a negative or marginal impact on UPNY/SENY were eliminated. This removed Projects 8, 13, and 19b from consideration. Second, those with a High environmental ranking were eliminated as projects with the same or better Power Flow results and lower environmental impacts remained. This eliminated Projects 1-5 (all of NAT’s portfolios), 10, 15, 17, and 18. Third, any projects with a Benefit/Cost Ratio below 1.0 were eliminated as not being able to meet the public policy needs outlined above. This removed both of Boundless’ projects, 20 and 21 from consideration. Trial Staff then winnowed out projects with a Medium environmental rating and a Power Flow impact of less than 900 MW on UPNY/SENY or a negative impact on Central East. This removed Projects 7 and 12 from further consideration.

These screens reduced the number of projects being considered for recommendation by Trial Staff to Projects 6/19a, 9, 11, 14, and 16 remaining.

Figure 19 – Comparison of Remaining Proposed Projects

Millions 2015 $	P19a NextEra	P6 NYTO	P9 NYTO	P16 NextEra	P11 NYTO	P14 NYTO
MONETIZED COSTS (PVRR)	**$648**	**$887**	**$887**	**$1,166**	**$1,671**	**$1,713**
Monetized Benefits						
Production Cost Savings	$221	$221	$262	$221	$516	$547
Capacity Resource Savings	$285	$284	$286	$285	$286	$286
RPS/CO2 Goals	$27	$27	$41	$27	$97	$108
Avoided Transmission Cost	$264	$281	$260	$998	$998	$995
Total Tax Benefit	$87	$142	$151	$40	$151	$169
TOTAL MONETIZED BENEFIT	**$884**	**$955**	**$1,000**	**$1,571**	**$2,048**	**$2,105**
BENEFIT COST RATIO	**1.36**	**1.08**	**1.13**	**1.35**	**1.23**	**1.23**
NET PRESENT VALUE (Monetized PVRR)	$236	$68	$113	$405	$377	$392
UPNY-SENY NTC MW	961	918	1,038	961	939	1,136
CENTRAL EAST NTC MW	50	50	50	50	375	375
UPNY-SENY ETC MW	1,747	1,686	2,091	-	1,621	2,286
ENVIRONMENTAL IMPACTS RANK	Low	Low	Low	Medium	Medium	Medium
HUDSON RIVER CROSSING	None	None	Full-Leeds	None	None	Full-Leeds

Notes: Notes: NTC=Normal Transfer Capability; ETC=Emergency Transfer Capability; PVRR=Present Value Revenue Requirement)

Trial Staff did, however, examine one additional option, as requested by the Applicants during the Technical Conferences. Trial Staff, in conjunction with the NYISO, evaluated the possibility of building the Roseton-Fishkill segment proposed by Boundless together with either Project 9 or 14. The theory behind this examination was that the ability of Boundless' proposed Roseton-Fishkill line to carry additional capacity from CPV Valley could increase the ability of Project 9 or 14 to move power across UPNY/SENY and therefore result in higher net benefits for a relatively small additional cost.

Examination of this theory however, proved that this was not the case. While combining these projects did produce additional transfer capability across UPNY/SENY, these gains were marginal compared to the increased cost, meaning any combination project saw a reduction in overall benefit. A full examination of these combinations is contained in the figure below.

Figure 20 – Examination of Value of Combination Projects

Millions 2015 $	Combo 1 P14&P21a	Combo 3 P9&P21a	Combo5 P11&P21a	Combo 1 Val Add P14&P21a	Combo 3 Val Add P9&P21a	Combo5 Val Add P11&P21a
MONETIZED COSTS (PVRR)	**$2,194**	**$1,368**	**$2,152**	**$481**	**$481**	**$481**
Monetized Benefits (PVRR)						
Production Cost Savings	$547	$262	$516	$0	$0	$0
Capacity Resource Savings	$286	$286	$286	$0	$0	$0
RPS/CO2 Goals	$108	$41	$97	$0	$0	$0
Avoided Transmission Cost	$995	$260	$998	$0	$0	$0
Total Tax Benefit	$288	$266	$277	$119	$115	$126
TOTAL MONETIZED BENEFIT	**$2,224**	**$1,115**	**$2,174**	**$119**	**$115**	**$126**
BENEFIT/COST RATIO	**1.01**	**0.82**	**1.01**	**0.25**	**0.24**	**0.26**
NET PRESENT VALUE (Monetized PVRR)	$30	($253)	$22	($362)	($366)	($355)
UPNY-SENY NTC MW	1,654	1,480	1,313	518	442	374
CENTRAL EAST NTC MW	375	50	375	0	0	0
UPNY-SENY ETC MW	2,204	2,013	1,826	(82)	(78)	205
ENVIRONMENTAL IMPACTS RANK	Med/Low	Low	Med/Low			
HUDSON RIVER CROSSING	Full-Leeds	Full-Leeds	None			

Notes: NTC=Normal Transfer Capability; ETC=Emergency Transfer Capability; PVRR=Present Value Revenue Requirement)

In reviewing all factors, the transmission facilities, upgrades, and replacements proposed by the NYTOs in Project 11 best meet all public policy objectives.

First, from an environmental perspective, Project 11 does not result in the construction of any facilities across the Hudson River, whether via a new circuit or a reconductoring or replacement of an existing circuit. This avoids impacts to sensitive environmental and scenic resources and is a major benefit of Project 11 over Project 14. With the exception of new substation or switchyard facilities, Project 11, like all other projects remaining for consideration, would be located entirely within existing ROW, further reducing environmental impacts.

From a Power Flow standpoint, Project 11 results in a 961-MW increase of the UPNY/SENY NTC with CPV Valley in service. This is very close to the Commission's original goal of moving an additional 1000 MW over the UPNY/SENY interface. Projects 6 and 19a are capable of moving a similar amount of power across this interface; however, Project 11 also results in a 375-MW increase in the Central East NTC, whereas other projects only increased the Central East NTC by 25-50 MW, which leads to higher production cost savings in the Brattle MAPS modeling and ultimately more benefits for New York.

Trial Staff recommends Project 11 over Project 16 based on this type of comparison. Project 11 includes an Edic-New Scotland segment, while Project 16 includes a Marcy-Princetown segment that does not involve the building of a new circuit to New Scotland. With respect to UPNY/SENY, these projects are nearly identical. Project 11 and 16 have different impacts on Central East voltage limits, however. Project 11 increases the Central East thermal limit by 412 MW, while Project 16 only results in an increase of 56 MW. This is because the transmission segments between Princetown and New Scotland in Project 16 become limiting, as there is not enough transmission to carry the increased power all the way to New

Scotland. This means that the Marcy-Princetown segment proposed in Project 16 would be underutilized, resulting in less production cost savings and ultimately less benefit from the line. Project 16 therefore is recommended for elimination by Trial Staff.

Project 11 also results in other Public Policy Benefits, such as the potential for interconnection of new generation sited Upstate (including renewable generation), increased employment in the form of construction and other jobs, a reduction of $97 million in the cost associated with meeting RPS/CO2 goals, $998 million in avoided future transmission refurbishment costs on Edic-New Scotland line, $286 million in capacity resource savings, $516 million in production cost savings, $151 million in increased tax revenue, and finally an increased ETC rating of 1,621 MW on UPNY/SENY.

Figure 21 – Value Added Analysis of Remaining Proposed Projects

Millions 2015 $	P6 over P19a Val Add	P9 over P19a Val Add	P16 over 19a Val Add	P11 over P19a Val Add	P14 over P19a Val Add	P14 over P11 Val Add
MONETIZED COSTS (PVRR)	**$239**	**$239**	**$518**	**$1,023**	**$1,065**	**$42**
Monetized Benefits						
Production Cost Savings	$0	$41	$0	$295	$326	$31
Capacity Resource Savings	($1)	$1	$0	$1	$1	$0
RPS/CO2 Goals	$0	$14	$0	$70	$81	$11
Avoided Transmission Cost	$17	($4)	$734	$734	$731	($3)
Total Tax Benefit	$55	$64	($47)	$64	$82	$18
TOTAL MONETIZED BENEFIT	**$71**	**$116**	**$687**	**$1,164**	**$1,221**	**$57**
BENEFIT COST RATIO	**0.30**	**0.49**	**1.33**	**1.14**	**1.15**	**1.36**
NET PRESENT VALUE (Monetized PVRR)	($168)	($123)	$169	$141	$156	$15
UPNY-SENY NTC MW	(43)	77	0	(22)	175	197
CENTRAL EAST NTC MW	0	0	0	325	325	0
UPNY-SENY ETC MW	(61)	344	-	(126)	539	665
ENVIRONMENTAL IMPACTS RANK	Low	Low	Medium	Medium	Medium	Medium
HUDSON RIVER CROSSING	None	Full-Leeds	None	None	Full-Leeds	Full-Leeds

Notes: NTC=Normal Transfer Capability; ETC=Emergency Transfer Capability; PVRR=Present Value Revenue Requirement)

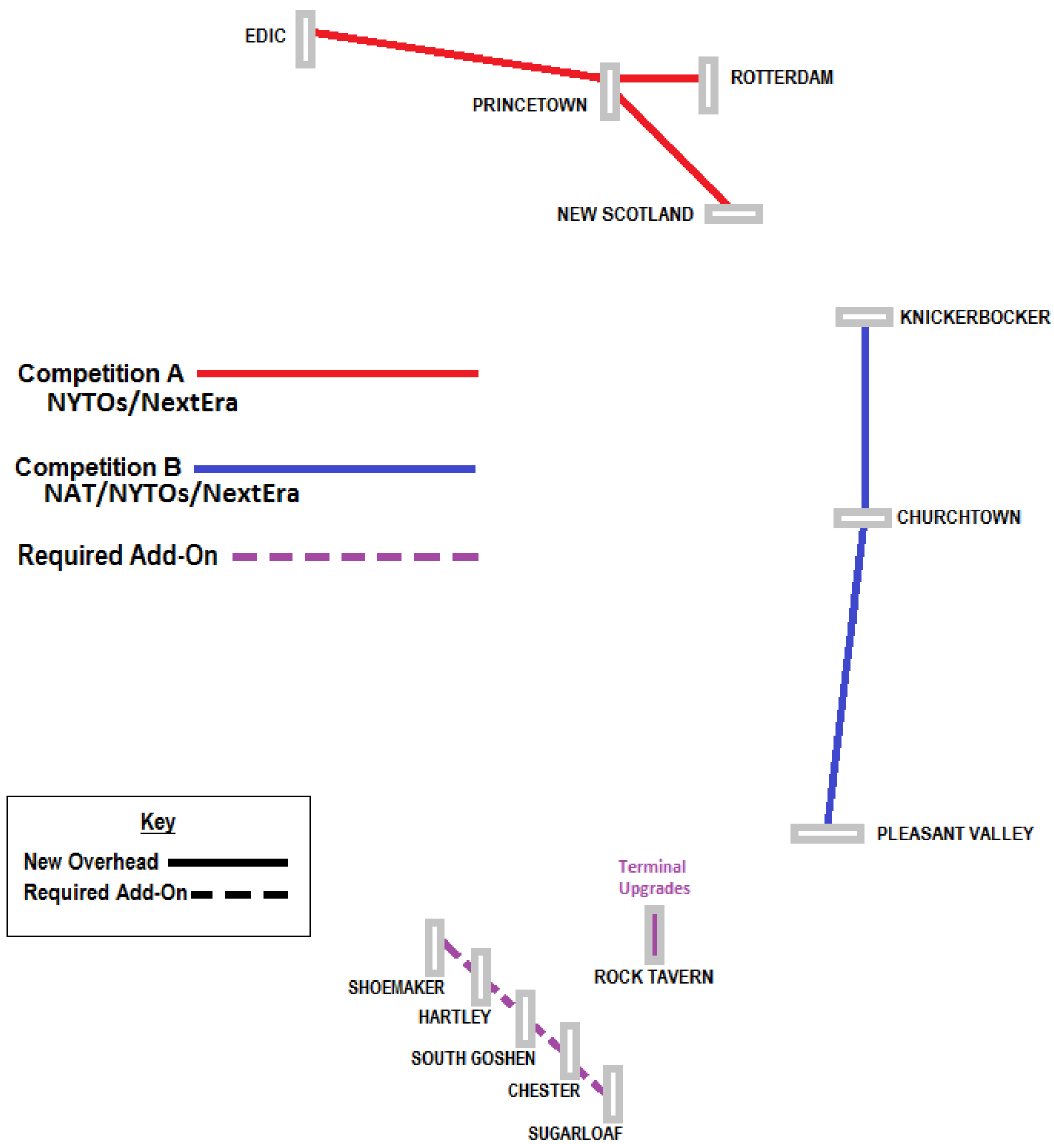
Other applicants proposed the same or similar work in the same transmission corridors as Project 11. In examining the various cost estimates filed by the Applicants, DPS Staff has determined that the net benefits presented by Project 11 could conceivably be higher if other developers were given an opportunity to bid the project rather than solely selecting the NYTOs. Therefore, in order to promote competition and encourage the lowest cost project to be built in the interest of ratepayers, Project 11 should be divided into two segments, each open to competition: Edic-New Scotland reconfigurations (NYTOs and NextEra); and Knickerbocker-Pleasant Valley reconfigurations (NAT, NextEra, and NYTOs). These respective developers proposed the same or similar work in these corridors.

NAT's Application included an indication that it could develop the Knickerbocker–Pleasant Valley segment exclusive of the New-Scotland–Knickerbocker portion of its Alternate 2 scenario (as described above in Scenario 5 description). NAT proposed the construction of a 345 kV overhead transmission line from Knickerbocker to Pleasant Valley in an existing 115 kV ROW. The NAT Scenario 5 (Alternative 2) uses the same 115 kV ROW as the proposed by the NYTOs and NextEra. This segment would be assigned a comparative environmental ranking of Low.

The NYTOs proposed both segments in Project 11, NextEra proposed GB-PV in Project 19a and Marcy South-NS in Project 17. Staff is, however, only recommending that the Knickerbocker-Pleasant Valley segment be built, including the NYTOs proposed Greenbush Substation upgrades. This project is denoted as 19c in the Environmental Tables and would have the same impacts as those outlined for the NYTO's Knickerbocker-Pleasant Valley segment.

These developers for these segments should be invited by the Commission to file with the NYISO and receive development costs under the NYISO's tariff. A graphic representation of Trial Staff's recommendation is below.

Figure 22 – Recommended Segments Including Required Upgrades



In making its analysis of the applications it receives, the NYISO should consider the following factors:

- Cost
- Technology Being Used
- ROW Acquisition Costs by Non-Transmission Owners[42]

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[42] Staff notes that questions remain regarding competitive applicant's access to existing ROW. Staff does not resolve how competitive developers would gain such access. Under the NYISO Open Access Transmission Tariff (OATT), Attachment Y, Sec. 31.4.6.3 Public Policy Requirements Planning process, any Applicant is required to indicate that it has "possession of, or an approach for acquiring, any necessary rights-of-way,

- Reliability/Operational Considerations of Proposed Work
- Differences in Power Flows Between Applicants

Further, any Applicant seeking to build the Knickerbocker-Pleasant Valley project must also work with Orange and Rockland to ensure that the Rock Tavern Substation Upgrades and Shoemaker-Chester-Sugarloaf line be upgraded as necessary to address identified system contingencies.

The facilities recommended by Trial Staff for a public policy need determination, and for advancement the NYISO, would all constitute transmission facilities subject to consideration under PSL Article VII and therefore, following the completion of the NYISO’s RFP process, any project selected would need to be reviewed by the Commission under Article VII. Trial Staff’s final recommendation for each proposed project is included in the table below.

Figure 23: Final Recommendations Regarding Proposed Projects

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property, and facilities that will make the proposal reasonably feasible in the required timeframe.” In making its determination, the NYISO will consider “whether the Developer: (i) already possesses the rights of way necessary to implement the solution; (ii) has completed a transmission routing study, which (a) identifies a specific routing plan with alternatives, (b) includes a schedule indicating the timing for obtaining siting and permitting, and (c) provides specific attention to sensitive areas (e.g., wetlands, river crossings, protected areas, and schools); or (iii) has a specified a plan or approach for determining routing and acquiring property rights.” Sec. 31.4.8.1.6.

Portfolio	Impact on Environment		UPNY-SENY NTC Limit Increase (MW)	Benefit/Cost Ratio	Disposition
P1 - NAT	HIGH		2,106		Eliminated (2)
P2 - NAT	HIGH		1,710		Eliminated (2)
P3 - NAT	HIGH		2,138		Eliminated (2)
P4 - NAT	HIGH		1,463		Eliminated (2)
P5 - NAT	HIGH		1,524		Eliminated (2) in Part Retained in Part (KB-PV)
P6 - NYTO	LOW		918	1.1	Retained in Full
P7 - NYTO	LOW		352	1.3	Eliminated (4)
P8 - NYTO	LOW		(330)		Eliminated (1)
P9 - NYTO	LOW		1,038	1.1	Eliminated (5)
P10 - NYTO	HIGH		1,206		Eliminated (2)
P11 - NYTO	MEDIUM		939	1.2	Retained in Full
P12 - NYTO	MEDIUM		432	1.3	Eliminated (4)
P13 - NYTO	MEDIUM		(329)		Eliminated (1)
P14 - NYTO	MEDIUM		1,136	1.2	Eliminated (5)
P15 - NextEra	HIGH		TBD		Eliminated (2)
P16 - NextEra	MEDIUM		TBD		Eliminated (6)
P17 - NextEra	HIGH		TBD		Eliminated (2) in Part, Retained in Part (M-NS)
P18 - NextEra	HIGH		TBD		Eliminated (2)
P19a - NextEra	LOW		961	1.4	Retained in Full
P19b - NextEra	MEDIUM		N/A		Eliminated (1)
P20 -Boundless	MEDIUM		687*	0.7	Eliminated (3)
P21 -Boundless	LOW		605*	0.7	Eliminated (3)

Notes
1: Eliminated due to Negative UPNY/SENY Impact
2: Eliminated due to High Environmental Ranking
3: Eliminated due to Benefit/Cost Ratio below 1.0
4: Eliminated due to Medium or Low Environmental Ranking & Power Flow Below 900 MW on UPNY/SENY
5:Eliminated as result of on-balance final analysis
6:Eliminated based on Central East (production cost) impacts compared with P11 and 14.

CONCLUSION

The preceding Trial Staff Final Report recommends that the Commission declare a Public Policy need for transmission facilities to be built in the Mohawk and Hudson River Valleys. A Request For Proposals seeking proposals to reconfigure and upgrade transmission facilities segments from Edic substation to New Scotland and Rotterdam substations, and Greenbush or Knickerbocker substations to Pleasant Valley substations as identified in Scenarios 5a, 11 and 19a and described in this Report should be issued by the NYISO. The NYTOs and NextEra should be invited to apply to build both segments, and NAT should be invited to build the Greenbush or Knickerbocker to Pleasant Valley segment.[43] These facilities, locations and routes are most promising from an electric system benefit perspective, and are significantly more environmentally compatible primarily because they are designed to use existing rights-of-way, and generally replace existing facilities with new facilities while largely avoiding significant new intrusions into existing communities, landscapes and important farmland resources.

[43] Trial Staff notes that other developers will be able to participate in the NYISO process, however, only those specifically mentioned here should be eligible for cost recovery.

TABLES & APPENDICIES

APPENDIX 1

Benefit-Cost Analysis of Proposed New York AC Transmission Upgrades

PRESENTED TO

NYISO and DPS Staff

PRESENTED BY

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September 15, 2015

THE Brattle GROUP

Table of Contents

I. Problem Statement
Motivation for AC Transmission Upgrades

Needs identified: Recent studies have highlighted the need for the NY transmission system to be upgraded to replace aging infrastructure and to increase transfer capability into SENY

Benefits not fully addressed by CARIS: The existing approach for identifying economic projects through the NYISO Congestion Assessment and Resource Integration Study (CARIS) has not identified projects to be built due to its limited scope of benefits considered

- CARIS considers a narrow range of benefits, focusing solely on base case production cost savings over only a 10-year time horizon
- Some other benefits (i.e., reduced losses, capacity value, emissions reductions) are calculated but not incorporated into the benefit-cost analysis
- Evaluating new transmission beyond standard reliability planning criteria requires a consideration of a wide-range of benefits that transmission can provide to the system (*see 2013 WIRES report*)

Do transmission (Tx) projects provide net economic benefits if benefits are evaluated more broadly?

Source: Chang, Pfeifenberger, and Hagerty, " The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments," WIRES and The Brattle Group, July 2013, online at: http://www.wiresgroup.com/res_benefits_of_transmission.html ("2013 WIRES Report")

PSC AC Transmission Initiative

Public Service Commission (PSC) initiated a proceeding to examine potential transmission solutions to congestion identified at the Central East and UPNY-SENY bulk electric system interfaces

- In August 2014, the PSC identified a wide-range of benefits to be considered and solicited proposals from stakeholders
- In September 2014, the solicitation resulted in the submissions of transmission portfolios intended to meet the needs identified by the PSC with the capability of adding 1,000 to 1,200 MW of transfer capability to the UPNY/SENY interface as identified by the PSC
- In July 2015, the Department of Public Services (DPS) Trial Staff filed an interim report with the PSC that analyzed the 22 proposed portfolios based on their *environmental compatibility* and *electric system impacts* and identified 7 portfolios for further evaluation

DPS asked NYISO and The Brattle Group to help evaluate the benefits and costs of the proposed transmission portfolios

I. Problem Statement

Overview of Benefit-Cost Analysis

We developed a framework for calculating the benefits and costs of the proposed transmission portfolios and two non-transmission alternatives against a "do nothing" Business-as-Usual case

Scope of solutions considered:

- Transmission portfolios proposed through solicitation process
- A comparable generation solution based on an approach similar to CARIS
- A portfolio of resources pursued through the Reforming the Energy Vision (REV) proceedings

Solutions evaluated:

- We initially evaluated the benefits of all 22 proposed Tx portfolios, the Generation solution, and the REV portfolio prior to the release of the DPS interim report and the CPV Valley announcement in July 2015
- Since the release of the interim report, we updated the analysis to focus on 9 portfolios selected by DPS (7 from interim report plus 2 additional portfolios requested by DPS) and the REV resources, accounting for the expected addition of 670 MW CPV Valley in Zone G
- The Generation solution showed minimal benefits during the initial analysis without CPV Valley, therefore the analysis was not updated with CPV Valley

In this report, we provide the updated results (*with CPV Valley*) in the main body of the report and the prior results (*without CPV Valley*) in the Appendix

Scope of Benefit-Cost Analysis

Costs and benefits considered

- We analyzed a wide range of potential benefits for each solution compared to "no action"
- DPS provided capital cost and revenue requirement (RevReq) estimates for the Tx portfolios; we calculated generation costs based on NYISO's last demand curve reset, and REV costs based on a recent report done for DPS

Types of evaluation metrics

- From a societal perspective, we calculate benefits and costs based on the total costs either incurred or avoided (e.g., production costs savings, not LBMP impacts); for quantified benefits and costs, we present an NPV and benefit-to-cost ratio ("B:C ratio") over the economic life of each solution
- From a ratepayer perspective, we calculate benefits and costs based on the additional transmission revenue requirements added to ratepayers bills, and the impacts on generation charges accounting for wholesale energy and capacity market impacts

Scenarios and sensitivities

- Calculated the sensitivity of our analysis to key assumptions for each benefit analyzed
- Potential retirement of Indian Point (and other potential retirements) handled as a separate scenario

All present value calculations in this presentation are shown in 2015 dollars.

All other monetary values discussed are in nominal dollars unless stated otherwise.

Contents

II. Solutions Analyzed

Transmission Portfolios Evaluated

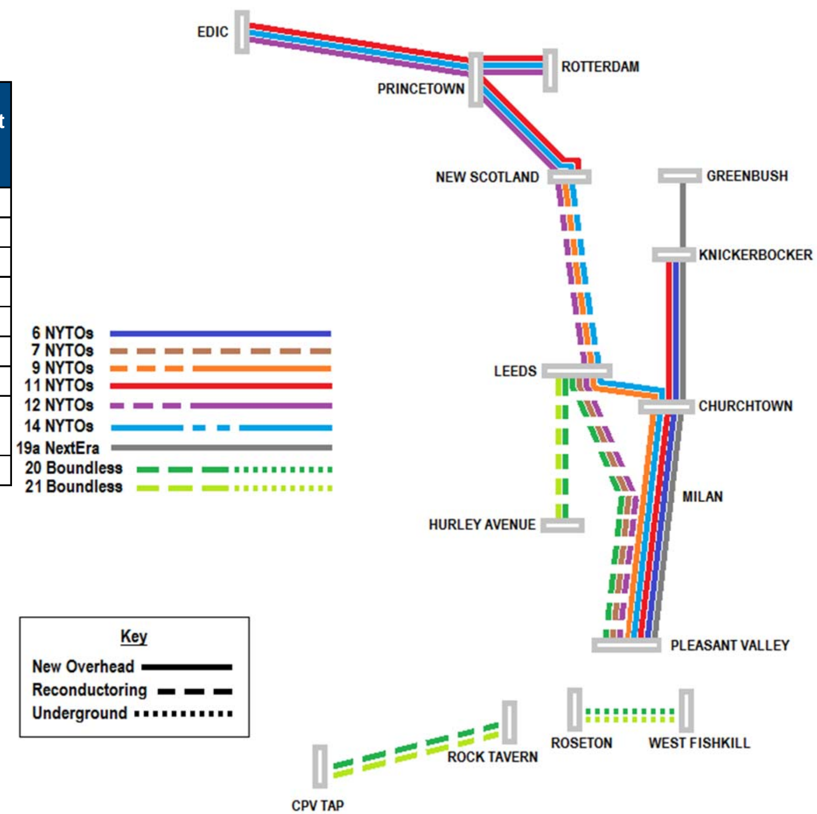
DPS requested detailed cost-benefit analysis of the 9 Tx portfolios listed below following the release of the interim report in July 2015

Summary of Transmission Portfolio Characteristics

Portfolio	Components	UPNY-SENY Normal N-1 Impact	UPNY-SENY Emergency N-1 Impact	Central East Voltage Impact
P6 - NYTO	KN-PV	918	1,686	50
P7 - NYTO	LD-PV reconductor	352	1,404	25
P9 - NYTO	NS-LD reconductor, LD-PV	1,038	2,091	50
P11 - NYTO	Edic-NS, KN-PV	939	1,621	375
P12 - NYTO	Edic-NS, NS-LD reconductor, LD-PV reconductor	432	1,341	375
P14 - NYTO	Edic-NS, NS-LD reconductor, LD-PV	1,136	2,286	375
P19a - NextEra	GB-KN-CH-PV	961	1,747	50
P20 - Boundless	NS-LD SR, (LD-PV, L-H, CPV-RT reconductor), LD-HA-R SC, RS-EF two cables	15	1,753	-25
P21 - Boundless	P20 minus LD-PV reconductor	-81	1,433	-25

Note: At request of DPS, we assume Athens SPS is removed in 2019 once the new facilities are energized. While Athens SPS is in effect, Leeds-PV and Athens-PV can reach their STE ratings following the loss of a parallel circuit, assuming there is sufficient Athens generation to guarantee flows return to or below their LTE ratings within 15 minutes.

Schematic of Transmission Portfolios



(*See Appendix for acronym definitions*)

II. Solutions Analyzed

Generation Solution

Developed alternative generation solution based on 2013 CARIS approach, with capacity similar to the increase in UPNY/SENY transfer capability provided by the Tx portfolios of 1,000 MW – 1,200 MW

- Added four 330 MW Combined Cycle units, for a total of 1,320 MW
- Units spread across Zone G high load buses
- 7,000 Btu/kWh full load heat rate
- 25-year economic life

Alternative 45-Year economic life case: Evaluated an alternative 45-year economic life case that assumes fixed O&M costs continue at the same annual rate (although they would typically be expected to increase) for an additional 20 years, while enjoying 20 more years of benefits

Note: The Generation solution was only analyzed for the case without CPV Valley and showed negative net benefits. It is anticipated that with CPV Valley, net benefits would not be better and therefore we did not re-analyze the Generation solution with CPV Valley. We thus present only the without-CPV Valley analysis results in the Appendix.

REV Resources Solution

Identified portfolio of REV resources capable of reducing SENY peak load by 1,200 MW based primarily on Generic Environmental Impact Statement (GEIS) "Lower" scenario

- Distributed REV resources among Zones G-J based on current penetration and potential for future growth
  - Started with near- to mid-term potential of REV resources from GEIS and distributed each resource across NY zones based on current and forecast levels of capacity impact from Gold Book long-term forecast and other sources (using the current capacity impact only if a forecast was not available)
  - Resulting capacity grossed up to 1,200 MW, keeping resource mix and distribution among zones constant
- Energy savings based on LBMPs from GE-MAPS Base Case (with CPV Valley) and capacity factors from GEIS analysis; the EE capacity factor in GEIS (~75%) is higher than capacity factor implied for Zone J "energy program impacts" in Gold Book (~65%), likely overstating energy savings
- We assume resources will be phased in from 2016 – 2020 (20% of total each year, consistent with GEIS assumptions) and remain in operation over reasonable measure life

REV Portfolio Summary by Resource Type and Zone

	Capacity Savings (MW)					Annual Energy Savings (GWh)					Measure Life
Resource Type	G	H	I	J	**Total**	G	H	I	J	**Total**	years
Energy Efficiency	91	23	50	673	**838**	598	154	328	4,417	**5,497**	12
Customer-sited Renewables	23	6	5	40	**73**	31	8	7	53	**98**	25
Combined Heat & Power	1	0	0	27	**28**	4	0	0	190	**195**	20
Demand Response	7	1	5	76	**89**	0	0	0	0	**0**	10
Fossil Fuel Distributed Generation	0	0	0	0	0	0	0	0	0	0	--
Grid Integrated Vehicles	2	1	1	11	**15**	0	0	0	-1	**-2**	10
Storage (flywheel and battery)	6	2	4	29	**40**	-1	0	0	-3	**-5**	15
Rate Structures	9	2	6	100	**117**	0	0	0	0	**0**	15
Total	**139**	**34**	**71**	**956**	**1,200**	**632**	**161**	**335**	**4,656**	**5,783**	

Sources: REV GEIS. See slide 51 for sources supporting resource distribution and economic life estimates

Contents

Net Benefits in Change Cases vs. Base Case

Compared Change Case with each proposed Transmission portfolio, Generation or REV Resources to a business-as-usual Base Case

- Costs reflect estimated capital costs of each portfolio, and the associated revenue requirements
- Benefits include any avoided costs and in-state tax receipts that differ from Base Case
- Costs and benefits analyzed over life of assets (45 years for Tx) and discounted to present value by applying a discount rate of 9.13% (corresponding to a pre-tax WACC) as requested by DPS
  - *Note*: The Brattle team members typically use an after-tax WACC, which would be 5.6% based on consistent assumptions; DPS's use of a higher discount rate will show lower NPV of Tx projects, since benefits tend to increase and costs tend to decrease over time (*see sensitivity analysis on slide 17*)

Summary of Base Case and Change Case Key Assumptions

	Base Case	Change Case
Transmission	Aging facilities refurbished over next 20 years (including several lines in 2020) based on 2012 STARS Report	New Tx facilities energized in 2019; may accomplish or facilitate needed refurbishments or upgrade existing lines
Generation	Capacity based on 2014 Gold Book with adjustments for recent announcements (incl. CPV Valley and capacity sales into ISO-NE); generic entry occurs when ICAP prices reach Net CONE in each capacity zone	Generation re-dispatched; no major change in supply capacity but ICAP analysis recognizes lower LCRs affecting future entry/exit locations & timing
Demand	Grows as forecasted by 2015 Gold Book through 2024 and extrapolated through 2063 at annual growth rate for 2020 – 2025	Same as Base Case
Athens SPS	Expires in 2024	Expires earlier in 2019 only with addition of Tx portfolios; same as Base Case for Generation and REV

III.A. Benefit-Cost Analysis Results: Societal Impacts

Wide Range of Benefits Considered

Analyzed a wide range of potential benefits and quantified majority of benefits considered (mostly monetarily) and provided qualitative description for benefits not easily quantified

- **Monetized benefits**: production cost savings incl. emission allowances and factors not captured in MAPS; avoided refurbishment costs of aging Tx; capacity resource cost savings due to reduced LCRs enabling the exit of existing capacity and the delay and shift of new construction; reduced net cost of RPS goals; and tax receipts (just offsetting the tax cost)
- **Quantified (but not monetized) benefits**: employment impacts, generation retirement preparedness
- **Benefits described qualitatively**: reliability, storm resiliency, planning/operational flexibility, future capacity options on existing ROW, synergies w/other future transmission projects, relieving gas transport constraints, market competition & liquidity, employment, and environmental externalities (plus and minus)

Benefit Category	Benefit Type	Monetized	Quantified	Described	Little Impact
Production Cost Savings	Traditional Production Cost Savings (PCS)	✓			
	PCS from Reduced Energy Losses	✓			
	PCS from Factors Not Modeled in MAPS	✓			
	Reduced Ancillary Service Requirements				✓
	Mitigation of Non-Market Measures				✓
Avoided Tx Refurbishment Costs	Avoided Refurbishment Costs of Aging Lines	✓			
	Addition of Parallel Path Reduces Congestion during Refurbishment of Aging Lines	✓			
Capacity Resource Cost Savings	Reduced Installed Reserve Margin (IRM)				✓
	Reduced Local Capacity Requirement (LCR)	✓			
	Generation Retirement Preparedness		✓		
RPS/CO_2 Goals	Reduced Net Cost of Meeting RPS Goals	✓			
Tax Receipts	Increased Tax Receipts	✓			
Environmental	Reduced Emissions of Air Pollutants		✓		
Economic	Employment Impact		✓		
Other Benefits	Market Benefits, Storm Hardening, Resiliency, etc.			✓	

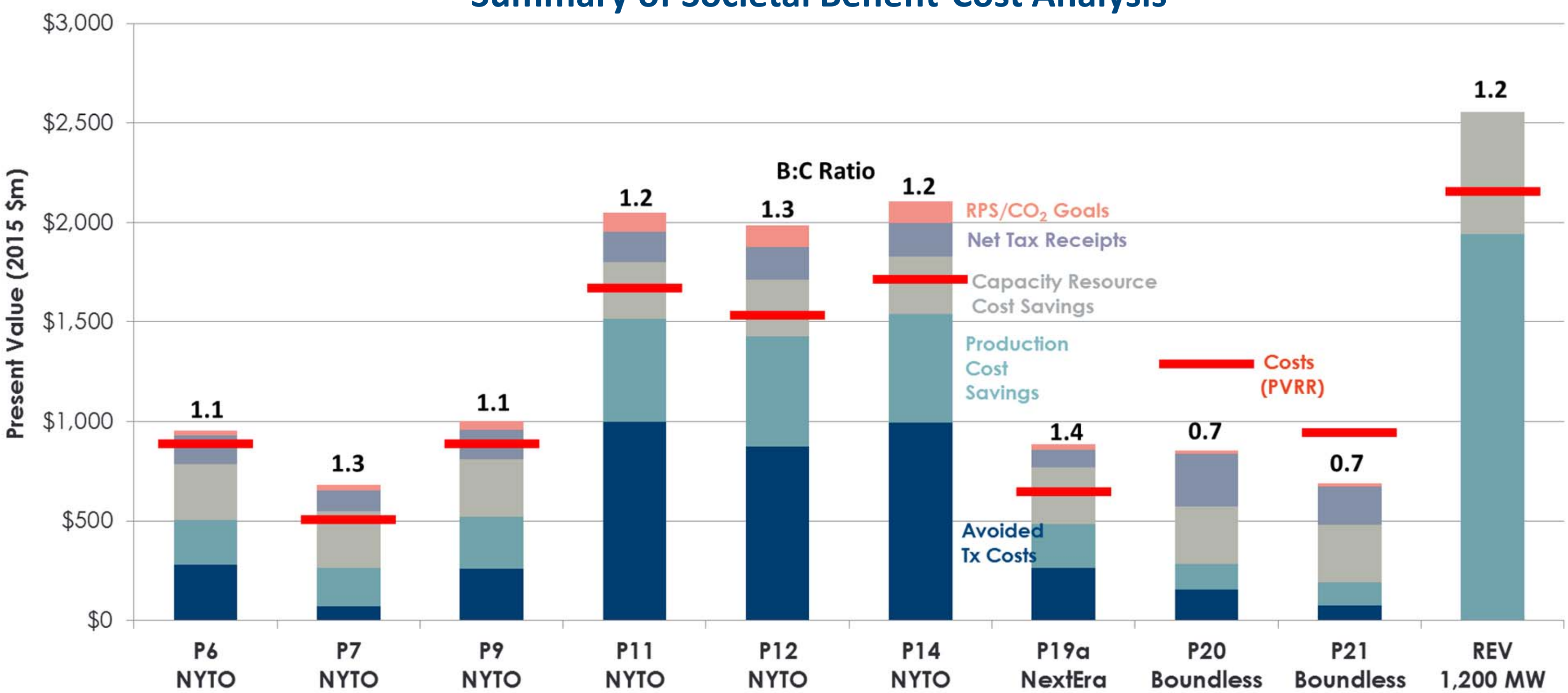
See: Chang, Pfeifenberger, and Hagerty, "The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments," WIRES and The Brattle Group, July 2013, online at: http://www.wiresgroup.com/res_benefits_of_transmission.html

Societal Benefit-Cost Analysis Results

Our analysis found net societal benefits for 7 Tx portfolios and the REV resources

- P19a has the highest B:C ratio of 1.4; P12 has the highest NPV of $451m
- These projects reduce economy-wide costs to serve load and meet reliability and environmental objectives; they save fuel costs and capacity resource costs in excess of their own costs (based on DPS estimates)
- Accounting for non-monetized benefits (*see slide 16*) and a lower discount rate (*see slide 17*) would further increase net benefits of all Tx portfolios

Summary of Societal Benefit-Cost Analysis



Notes: Tx PVRRs are based on DPS's estimated 2015 capital costs, which differ from proponents' claimed costs (*see following slides*). State and local taxes shown on the benefits side cancel the non-federal taxes included in the PVRR of Tx portfolios.

III.A. Benefit-Cost Analysis Results: Societal Impacts

Detailed Societal Results with DPS Costs

The costs and benefits of the various portfolios differ as follows:

- Portfolios that extend through Central East (P11, P12, P14) have the highest NPVs ($380 – 450 million). Although they cost the most, they provide the greatest Production Cost Savings (PCS) and Avoided Tx Costs (by retiring Porter-Rotterdam, which is assumed in the Base Case to be refurbished in 2020).
- Portfolios that only add capacity along the Leeds-PV corridor (P6, P7, P9, P19a) have lower costs and lower benefits, but P19a has the highest B:C ratio of 1.4. Compared to larger projects, they provide less PCS and Avoided Tx Costs but similar Capacity Resource savings. All proposed portfolios provide similar increases in UPNY/SENY transfer capability (and those that provide slightly less prevent the G-J LCR from binding over the study period, so those that further expand transfer capability offer little incremental capacity value).
- The Boundless projects (P20, P21) achieve similar levels of benefits as the Leeds-PV upgrades but tend to be more expensive, resulting in negative NPVs.

Societal Benefit-Cost Analysis assuming DPS's Costs Estimates

Portfolio	DPS Estimated Capital Cost (2015 $m)	PVRR (2015 $m)	Production Cost Savings (2015 $m)	Capacity Resource Savings (2015 $m)	Avoided Tx Costs (2015 $m)	Net RPS Costs (2015 $m)	Total Tax Benefit (2015 $m)	Total Benefits (2015 $m)	NPV (2015 $m)	B/C Ratio
P6 - NYTO	$631	$887	$221	$284	$281	$27	$142	$956	$68	1.1
P7 - NYTO	$361	$508	$194	$284	$70	$31	$104	$683	$175	1.3
P9 - NYTO	$631	$887	$262	$286	$260	$41	$151	$1,001	$114	1.1
P11 - NYTO	$1,189	$1,671	$516	$286	$998	$97	$151	$2,049	$377	1.2
P12 - NYTO	$1,090	$1,533	$554	$286	$873	$108	$163	$1,984	$451	1.3
P14 - NYTO	$1,218	$1,713	$547	$286	$995	$108	$169	$2,105	$392	1.2
P19a - NextEra	$461	$648	$221	$285	$264	$27	$87	$884	$236	1.4
P20 - Boundless	$918	$1,291	$128	$288	$157	$17	$264	$854	-$436	0.7
P21 - Boundless	$671	$944	$115	$288	$76	$17	$193	$690	-$254	0.7

Note: See slides 46-47 for the relationship between capital cost and PVRR. See Section V for the analysis of benefits.

Detailed Societal Results with Proponent Costs

Assuming proponents' cost estimates instead of DPS's slightly increases net benefits of non-NYTO projects

- B:C ratio of NextEra's portfolio P19a increases from 1.4 to 1.6
- P21's B:C ratio increases by 0.1, but both Boundless projects remain less than 1.0
- A summary of the DPS and Proponent cost estimates is shown on slide 45
- *Note*: Other than the table below, the rest of this presentation uses DPS's cost estimates

Societal Benefit-Cost Analysis assuming Proponents' Cost Estimates

Portfolio	Proponent Estimated Capital Cost (2015 $m)	PVRR (2015 $m)	Production Cost Savings (2015 $m)	Capacity Resource Savings (2015 $m)	Avoided Tx Costs (2015 $m)	Net RPS Costs (2015 $m)	Total Tax Benefit (2015 $m)	Total Benefits (2015 $m)	NPV (2015 $m)	B/C Ratio
P6 - NYTO	$617	$867	$221	$284	$279	$27	$138	$949	$82	1.1
P7 - NYTO	$359	$505	$194	$284	$69	$31	$103	$682	$177	1.3
P9 - NYTO	$635	$893	$262	$286	$260	$41	$153	$1,002	$109	1.1
P11 - NYTO	$1,194	$1,679	$516	$286	$998	$97	$153	$2,050	$371	1.2
P12 - NYTO	$1,105	$1,553	$554	$286	$870	$108	$167	$1,984	$431	1.3
P14 - NYTO	$1,239	$1,741	$547	$286	$991	$108	$175	$2,106	$365	1.2
P19a - NextEra	$386	$543	$221	$285	$251	$27	$66	$849	$306	1.6
P20 - Boundless	$737	$1,036	$128	$288	$112	$17	$212	$757	-$278	0.7
P21 - Boundless	$510	$716	$115	$288	$38	$17	$147	$605	-$112	0.8

Note: See slides 46-47 for the relationship between capital cost and PVRR. See Section V for the analysis of benefits.

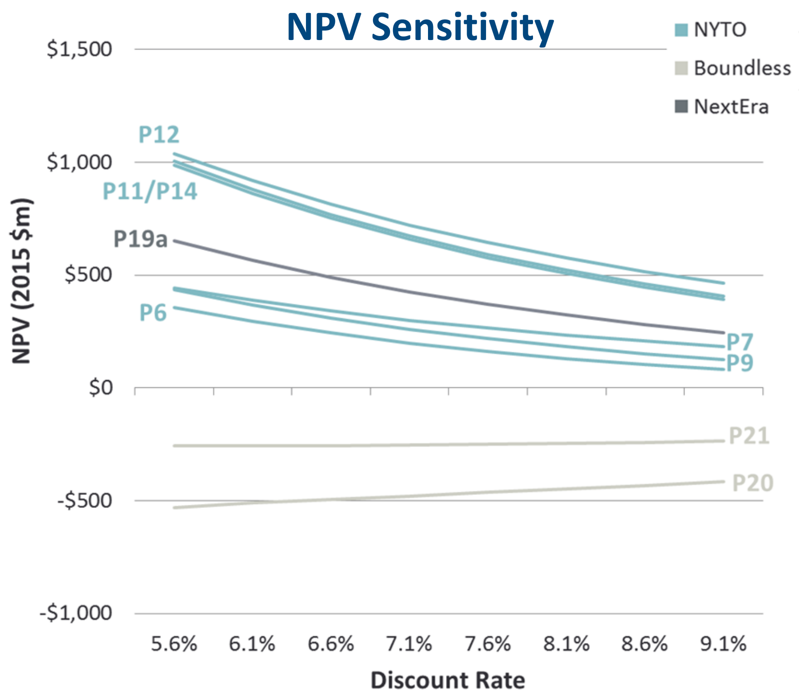
Non-Quantified Societal Benefits

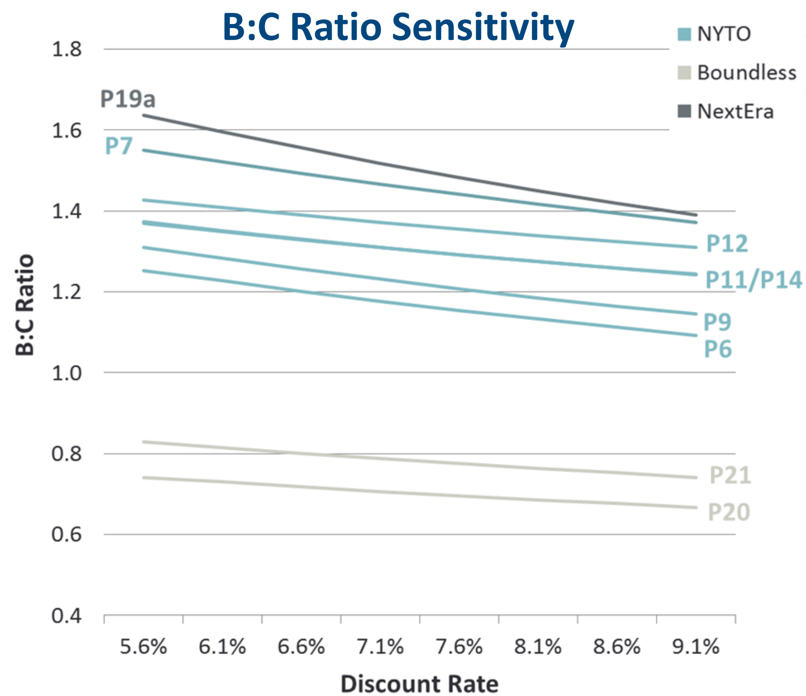
Benefit Category	Transmission	Generation	REV Resources
Protection against Extreme Conditions, including short-term operating events and long-term planning scenarios (accounting for these could increase the *expected value* of projects and the *insurance value* to risk-averse stakeholders)	Helps prevent or limit reliability and price-spike events and long term outages downstate; expected value conceptually included thru PCS multipliers, but they may not capture all possibilities; insurance value not quantified in our analysis.	Generation may also help during similar events, but provides less flexibility than Tx to rely on wide range of resources to limit cost excursions	Also protects against extremes; reducing net load is at least as good at balancing supply and demand as transmission that expands supply options
Market Benefits, including increased competition and liquidity	All projects increase competition and liquidity (access to trading Hubs)	May increase competition, depending on ownership	Net load reductions increase competition among suppliers
Storm Hardening and Resiliency	New facilities increase system resiliency due to updated construction standards; parallel path benefit may be limited for projects on existing ROW	Local resources may mitigate loss of T or G	Local load reductions and DG may mitigate loss of T or G
Maximizing Future Capacity Options on Existing ROW, e.g., by upsizing a circuit or making space for a 2nd future circuit	Most portfolios add more capacity than currently "needed" for reliability or congestion relief on existing ROW; none add space for future circuits	N/A	N/A
Synergies with Other Future Tx Projects, e.g., to deliver renewables or meet load growth	Projects extending north and west provide the most possibilities	May reduce the need for future Tx projects	May reduce the need for future transmission projects
Relieving Gas Transport Constraints	Few gas constraints in current system, but more Tx capacity may help in contingencies and in a future with more gas demand and changing flow patterns	Additional local gas demand may result in additional costs on a constrained system	If gas becomes constrained downstate, reduced electric/gas demand would help
Help Meet EPA Clean Power Plan Goals, by providing more flexibility for generation retirements	Reduces reliability and economic challenges with downstate retirements and provides additional capacity to connect remote resources with load	New CC will meet new source standard; does not impact existing source standard	Reduces consumption and emissions

Discount Rate Sensitivity Analysis

Analyzed impact of discount rate on NPV and B:C ratio by reducing DPS-recommended assumption of 9.13% at the high end to 5.6% (reflecting utility ATWACC) at the low end

- Lower discount rate increases NPV of most portfolios by $300 – 700m, but reduces the NPV of P20 and P21 by $100 – 200m due to benefits being small relative to its PVRR
- Due to back-weighted benefits of Tx projects, lower discount rates increase B:C ratios by 0.1 – 0.3
- The different composition of benefits (front-weighted vs. back-weighted) for each portfolio causes the slopes to differ by portfolio

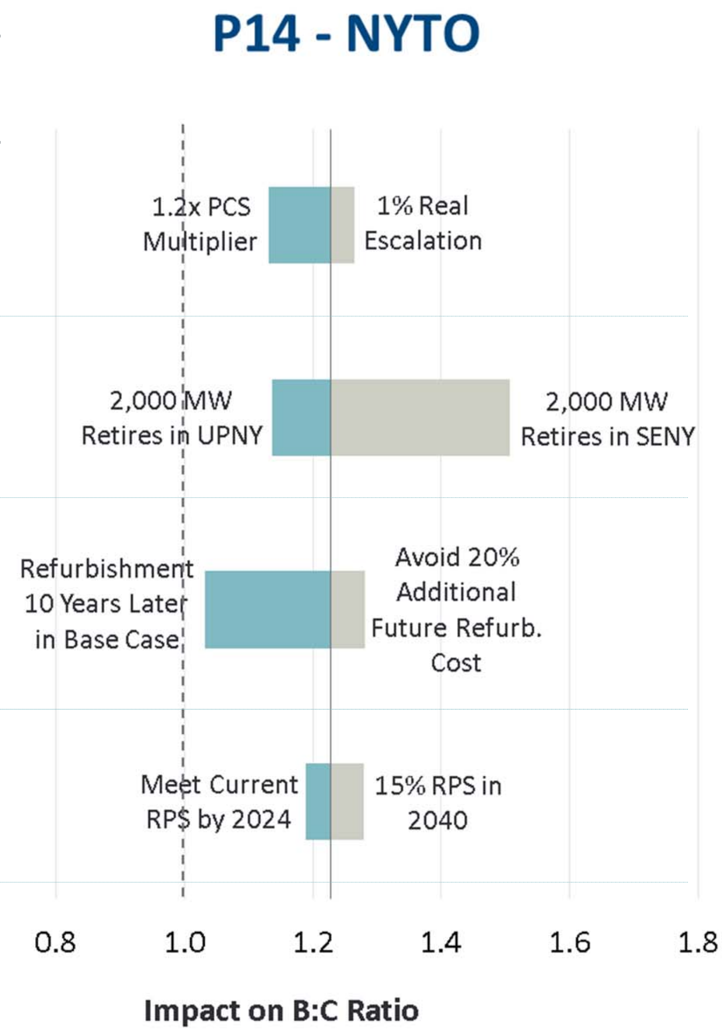




B:C Ratio Sensitivity Analysis of Benefit Assumptions

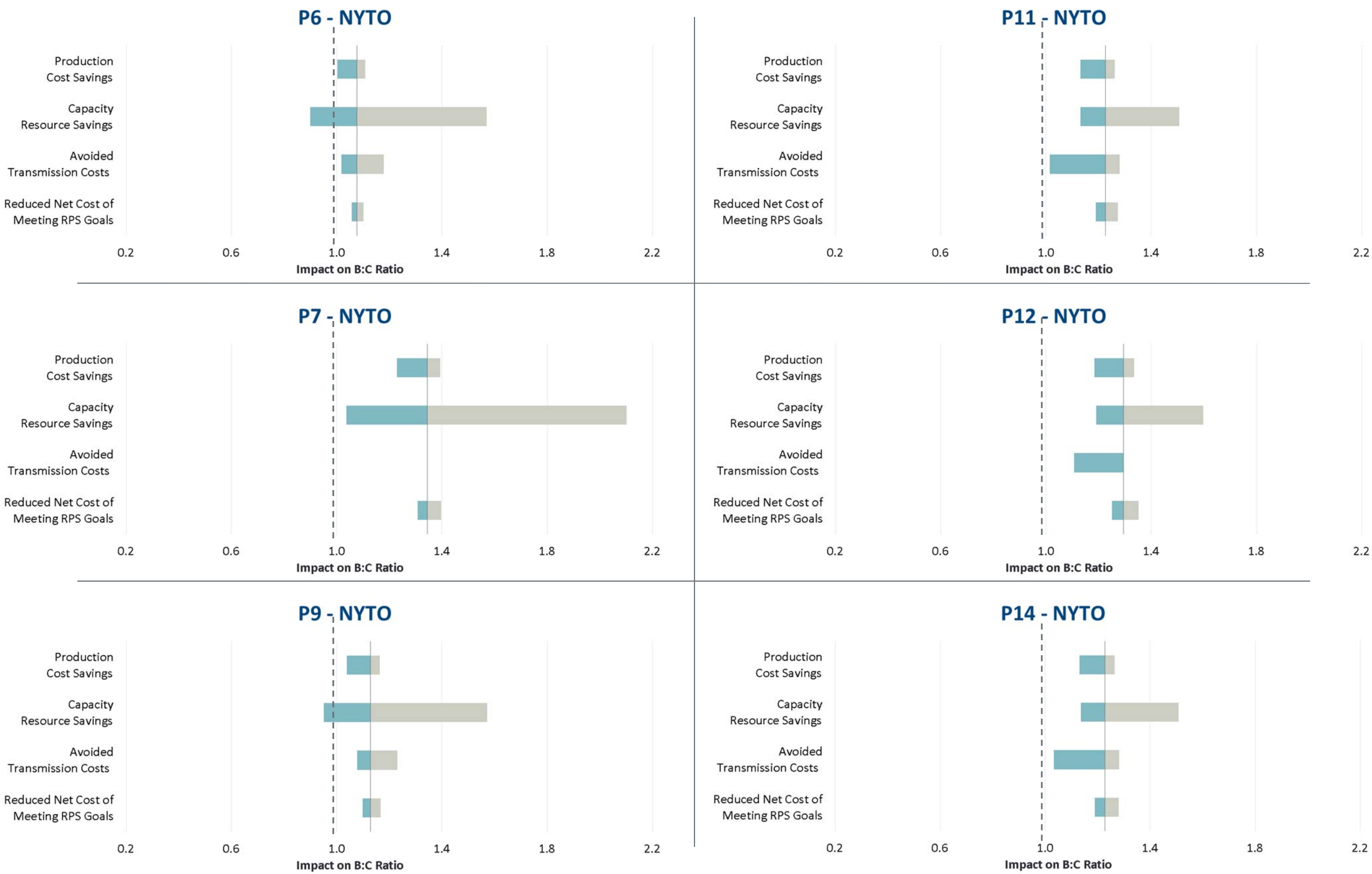
Sensitivity Analysis Assumptions

Benefit Category	Lower Value Case	Primary Assumption	Higher Value Case
Production Cost Savings (PCS)	Reduce PCS multiplier to 1.2x	Multiply MAPS PCS by 1.6 to account for factors not modeled in Base Case; escalate post-2024 PCS at inflation	Post-2024 PCS escalates at inflation + 1%
Capacity Resource Savings	2,000 MW retires in UPNY (with or w/o new Tx)	No exit of existing/planned supply, except in response to reduced LCRs	2,000 MW retires in SENY (with or w/o new Tx)
Avoided Transmission Costs	Refurbishment could be delayed 10 years	Projects that *refurbish* aging facilities get a "credit" based on the latest date indicated in STARS; projects that *facilitate* future refurbishments NOT credited for reducing future construction costs	Projects that add a parallel path to aging facilities reduce future refurbishment costs 20% (by avoiding extended construction)
Reduced Net Cost of Meeting RPS Goals	Meet current RPS by 2024 and no more thereafter	RPS increases in 2030 to 2x the 2024 RPS	15% RPS in 2040



Note: These cases represent the outer envelope of a larger set of sensitivities we considered; we did not test the sensitivity to uncertainty in project cost assumptions

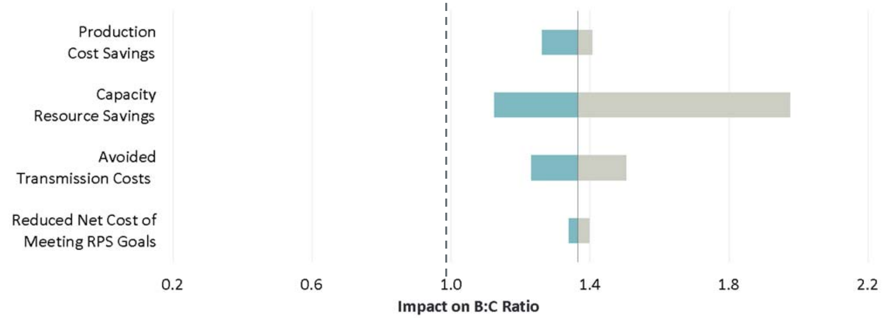
B:C Ratio Sensitivities Across Tx Portfolios



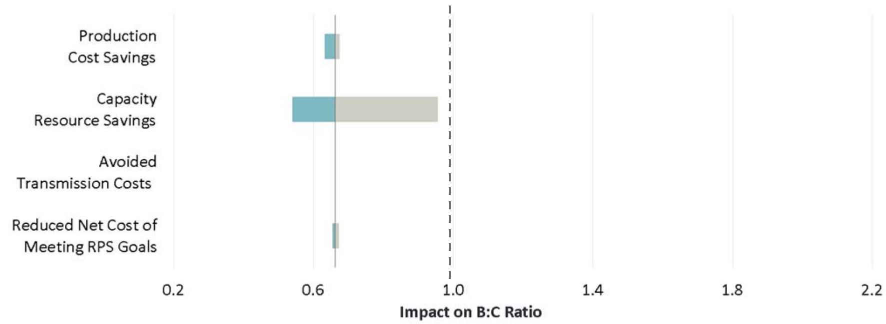
III.A. Benefit-Cost Analysis Results: Societal Impacts

B:C Ratio Sensitivities Across Tx Portfolios

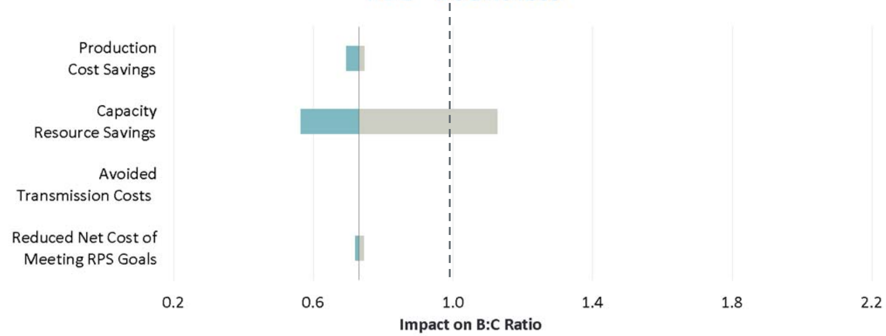
P19a - NextEra



P20 - Boundless



P21 - Boundless



Contents

Ratepayer Impact Analysis

Cost Allocation: Assume 90% of transmission RevReq allocated to SENY and 10% to UPNY

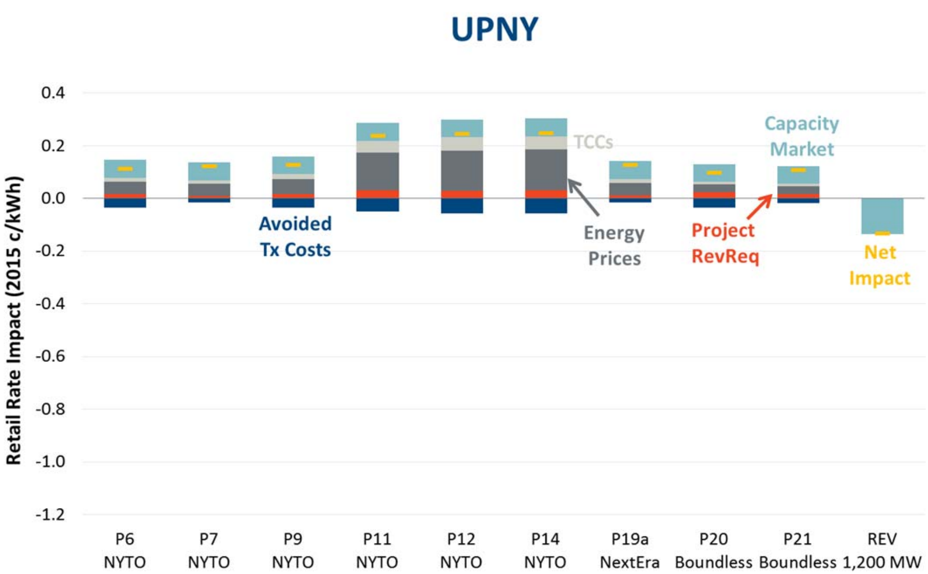
- PSC Order (Dec 2014) states, "75% of project costs are allocated to the economic beneficiaries of reduced congestion, while the other 25% of the costs are allocated to all customers on a load-ratio share"
- Order assumes majority of benefits occur SENY resulting in 90/10 split
- Generation and REV resource costs allocated 100% to SENY

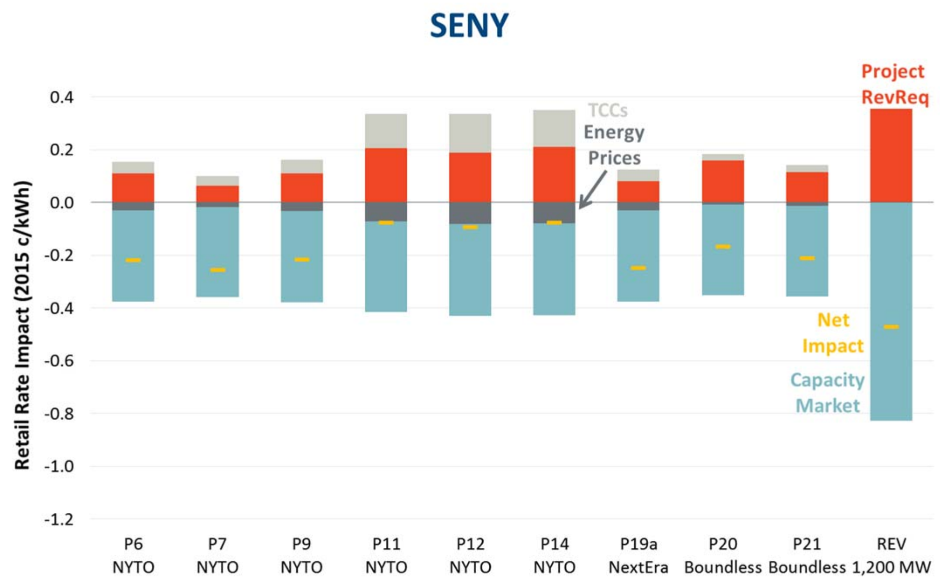
Rate Impacts of Quantified Benefits:

- *Energy Costs and Congestion Rents*:
  - Change in load*LBMP minus change in TCCs from MAPS, assuming 80% of TCC revenues accrue to Downstate ratepayers (based on 2014 data indicating 80% of TCC revenues are on TCCs sinking in SENY)
  - Change in TCC revenues multiplied by 0.9x (as defined in NYISO Economic Planning Process Manual)
  - Change in energy payments and TCC revenues increased by 1.6x to account for factors not modeled in MAPS, similar to production cost savings (*see slides 84-87 for explanation of this multiplier*)
  - *Note*: REV analysis does not include a measure of energy/TCC impacts because this case was not modeled in MAPS
- *Capacity Costs*: Change in zonal prices and cleared quantities from ICAP model; accounts for changes in energy prices affecting Net CONE
- *Avoided Transmission Costs*:
  - Calculated based on the year refurbishment costs would have been incurred in the Base Case
  - Apply same RevReq formula as the portfolio costs
  - Allocate savings to UPNY based on location of lines considered in our analysis

Tax Receipts: We note distribution of property and state income taxes to UPNY and SENY, even though the proceeds won't be included in ratepayer bills, and we provide examples illustrating our calculations

2019 Ratepayer Impacts





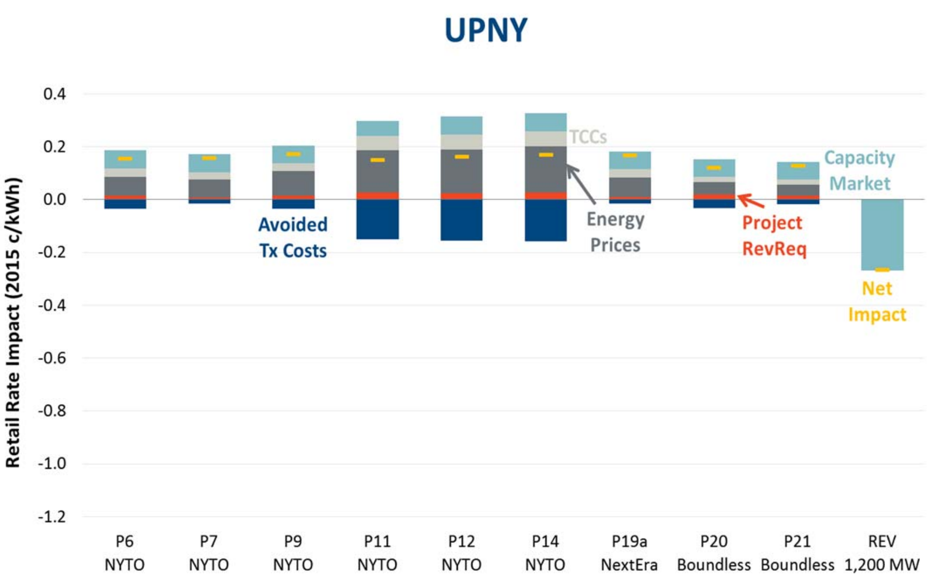
Net Tax Receipts in 2019 - UPNY

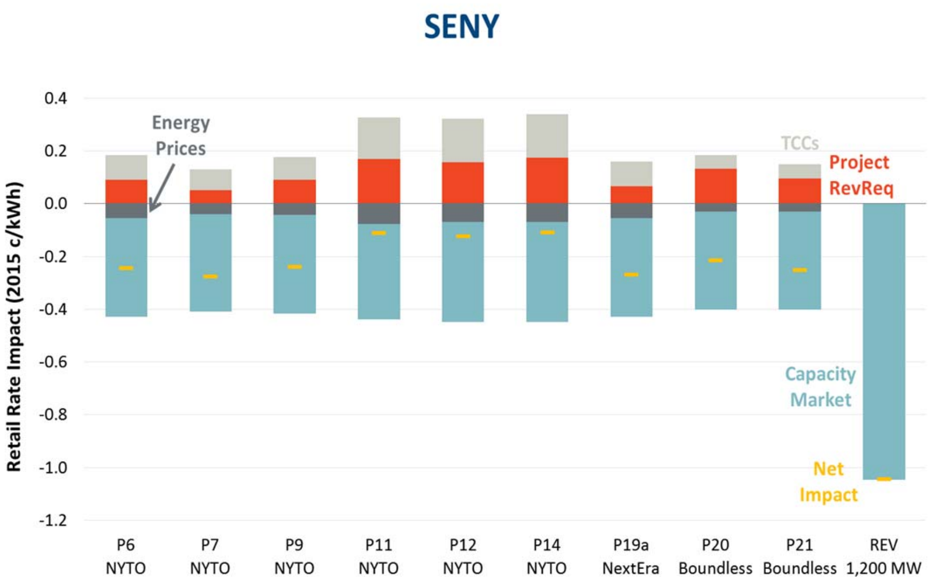
	P6	P7	P9	P11	P12	P14	P19a	P20	P21	REV
2015 $m	6	3	6	17	12	16	6	8	7	-
c/kWh	0.01	0.00	0.01	0.03	0.02	0.02	0.01	0.01	0.01	0.00

Net Tax Receipts in 2019 - SENY

	P6	P7	P9	P11	P12	P14	P19a	P20	P21	REV
2015 $m	5	4	5	7	7	7	4	12	10	-
c/kWh	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00

2024 Ratepayer Impacts





Net Tax Receipts in 2024 - UPNY

	P6	P7	P9	P11	P12	P14	P19a	P20	P21	REV
2015 $m	5	3	5	9	5	8	6	7	6	-
c/kWh	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00

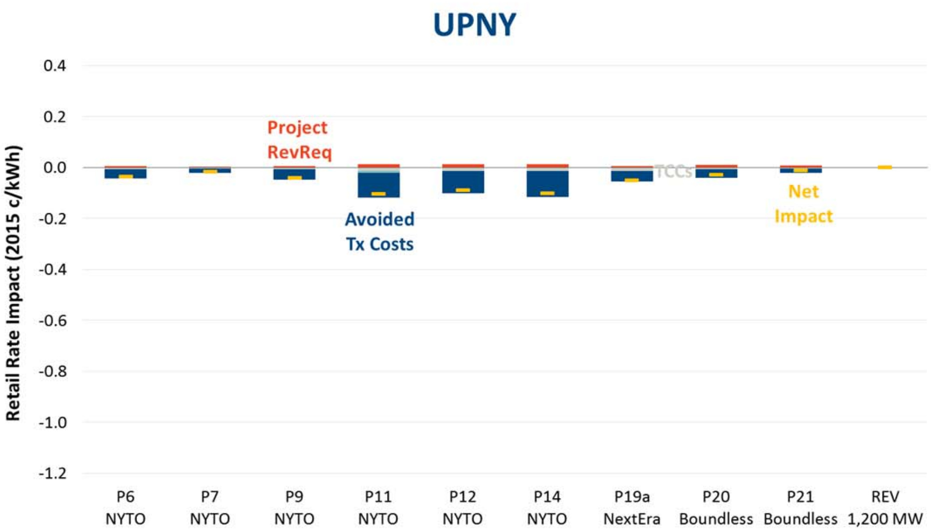
Net Tax Receipts in 2024 - SENY

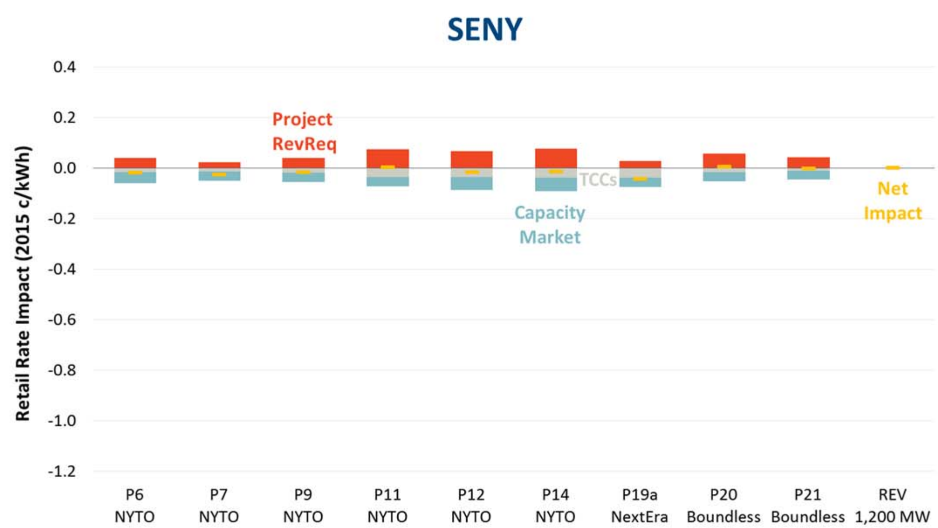
	P6	P7	P9	P11	P12	P14	P19a	P20	P21	REV
2015 $m	4	4	4	2	2	2	3	10	8	-
c/kWh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00

Long-Term Rate Impacts

Long-term rate impact analysis assumes market returns to Base Case price differentials

- Retirements, load growth, and new builds (more tilted to UPNY due to new transmission) eventually will fill up the additional transfer capacity until prices revert to base case levels
- By then, there is no energy price impact, but TCC revenues increase with increased flow
- We use simulated production cost savings as a proxy for the incremental TCC value (e.g., if the prices are $40 in UPNY and $50 in SENY with an additional 1,000 MW flow, the production cost savings and the incremental TCC values will both be $10 x 1,000 MW)
- Tax receipts would continue as well, though not shown on this slide
- Similarly, for the capacity market part of this analysis, we assume each zone reaches long-term equilibrium with prices at local Net CONE (but with lower LCR in SENY)



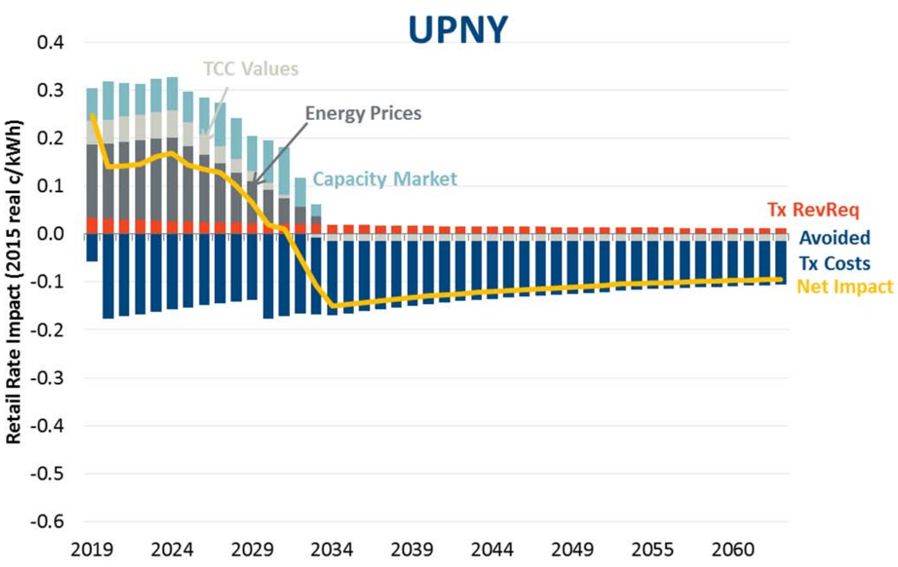


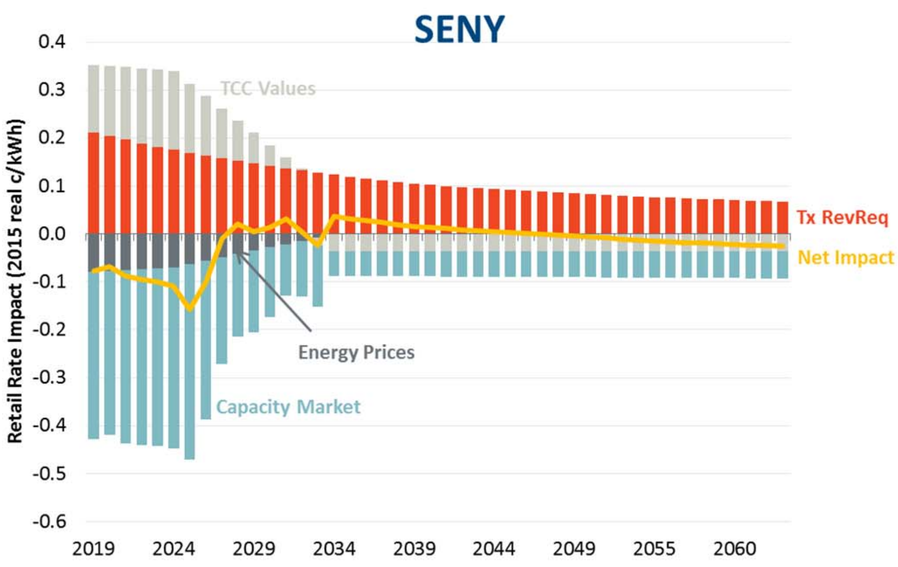
III.B. Benefit-Cost Analysis Results: Ratepayer Impacts

Annual Rate Impacts (P14 example)

Projected rate impacts depend on how long it takes to reach the "long-term" conditions described on the prior slide; for that reason, we present a "what-if" scenario below for P14, assuming it takes 15 years (to 2034)

- Energy Price and TCC Value impacts are linearly interpolated for 2020-2023 and 2025-2033 and then held constant in real terms beyond 2034
- Capacity Market impacts in 2034 and later assume price equals Net CONE
- Tx RevReq and Avoided Future Refurbishments calculated from RevReq analysis
- Tax receipts would continue as well over this 45-year timeframe (*see slide 28*)

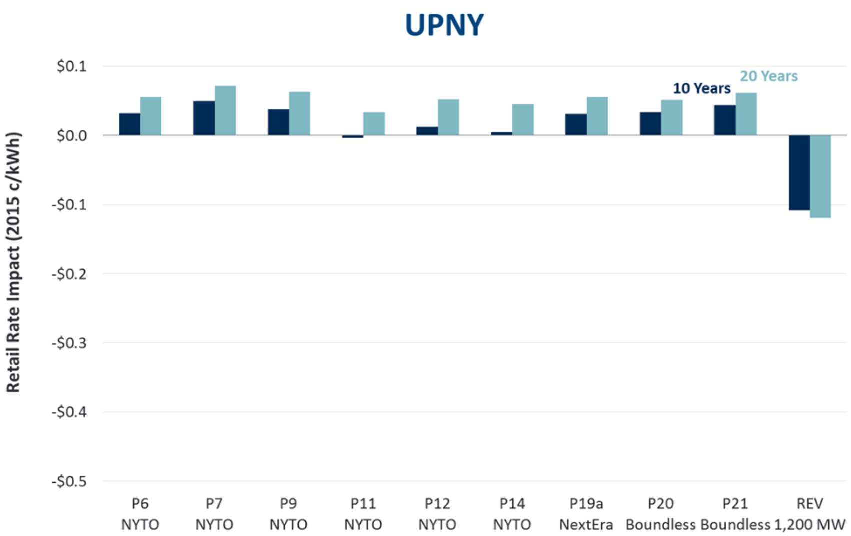


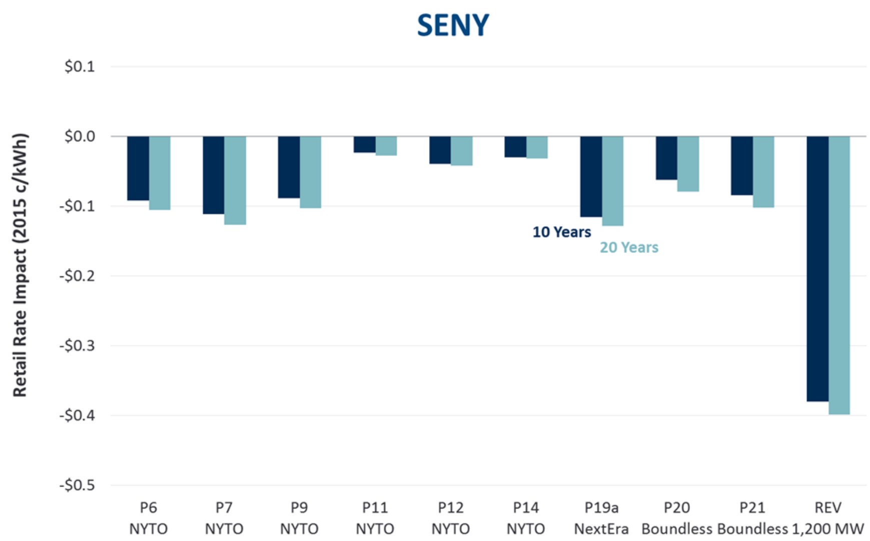


Levelized Rate Impacts

We calculated a levelized long-term rate impact for each project over 45 years

- Reflects a fixed rate (in real dollars) that if paid/saved annually over 45 years would have the same PV as the annual rate calculated for each project
- Levelized rate impact depends on how long it takes to reach equilibrium; chart below shows two "what-if" scenarios of reaching equilibrium in 10 or 20 years with rate impacts calculated by linearly interpolating between 2024 and either 2029 or 2039
- Based on the assumed cost allocation approach (with 10% of RevReq allocated to UPNY and 90% to SENY), most projects slightly increase levelized rates in UPNY and decrease them in SENY
- Adjusting the time-to-equilibrium from 10 to 20 years increases UPNY levelized rate impact by 0.02 – 0.04 c/kWh and decreases SENY levelized rate impact by 0.00 - 0.02 c/kWh





III.B. Benefit-Cost Analysis Results: Ratepayer Impacts

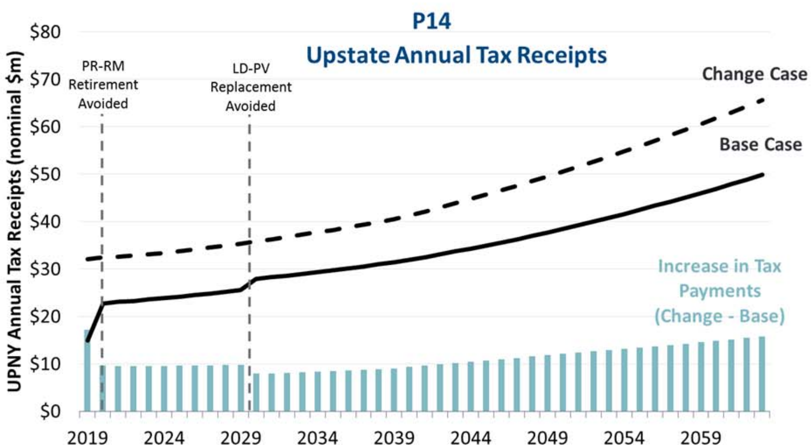
Projected UPNY Tax Receipt Impacts

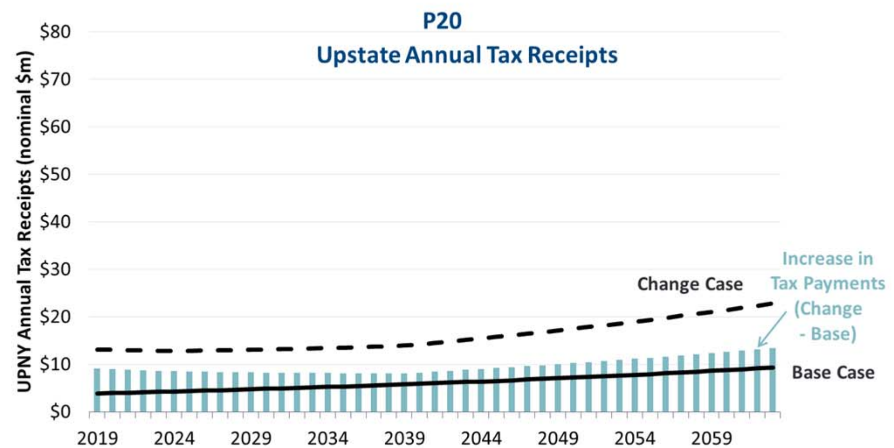
Tx portfolios increase tax receipts for UPNY municipalities

- New portfolios increase tax receipts based on the property taxes included in the portfolio's RevReq
- Increases offset by replacing existing facilities that would otherwise continue to pay taxes and by avoiding future refurbishments that would have increased tax payments and

Expected taxes paid in UPNY for P14 and P20 are shown for Base and Change Cases to demonstrate when and by how much tax payments are expected to change

- P14: Reconductors NS-LD, retires PT-RM, and replaces LD-PV
  - *Base Case*: Existing NS-LD line continues paying taxes, refurbishment of PT-RM increases taxes in 2020, and refurbishment of LD-PV increases taxes in 2030
  - *Change Case*: Addition of P14 portfolio increases taxes starting in 2019
- P20: Reconductors LD-PV, HA-LD, and CPV-RT
  - *Base Case*: Existing LD-PV, HA-LD, and CPV-RT lines continue paying taxes
  - *Change Case*: Addition of P20 portfolio increases taxes starting in 2019





Contents

Indian Point Retirement Scenario Overview

The possibility of Indian Point retiring (or other SENY retirements) would increase the value of new transmission into SENY

We analyzed benefits under a 2019 surprise retirement of Indian Point, comparing:

- The addition of new AC transmission portfolio
- Without new transmission, compensating generation must be added for reliability

MAPS Assumptions	IP-Out Base Case with Compensating Generation	IP-Out with Tx Solution
Generation	3 years with no additional generation, compensating generation online by 2022 sufficient to maintain reliability	No additional generation needed to maintain reliability
Transmission	No new additions	New Tx facilities energized in 2019

Societal benefits calculated as follows:

- <u>Production cost savings</u> calculated based on difference in production costs between the two cases described above with P14 as a representative Tx project
- <u>Capacity resource cost savings</u> based on 2,000 MW SENY retirement sensitivity; assume entry occurs at Net CONE as needed, starting in 2019 both with and without new transmission (*Note*: Tx benefits may be higher if it avoids adding more expensive compensating MW in the short-term)
- <u>Avoided refurbishment costs</u>, <u>tax receipts</u> and <u>net cost of RPS goals</u> are assumed to be equivalent to scenario with Indian Point operating

IP Retirement Production Cost and ICAP Impact

Production Cost Changes: While IP Retirement increases production costs in all cases, both Tx and Generation solutions mitigate production cost increases, with greater savings from Tx

- NYCA Adjusted Production Costs increase by $700m in 2019 and $900m in 2024 with the retirement of Indian Point and no additional Tx or generation
- Additional generation or transmission lowers production costs compared to the IP out Base Case
- Tx solution has lower production costs than Generation solution by $50m in 2019, $46m in 2024

ICAP Changes: Capacity in G-J decreases, but Tx Solution increases transfers into SENY

- Capacity decreases by **2,000 MW** with retirement of IP, assuming no additional Tx or Generation
- Tx solution results in **1,100 MW** less new capacity in G-J than in the Compensating Gen case (assuming new entry at net CONE)

Scenario	Production Costs ($m)		G-J Capacity (MW)	
	2019	2024	2019	2024
Base Case	$3,511	$4,277	16,548	16,548
IP-Out Base Case (no Compensating Generation)	$4,208	$5,187	14,548	14,548
IP-Out Base Case with Compensating Generation	$4,208	$5,169	15,555	16,014
IP-Out with Tx Solution	$4,159	$5,123	14,449	14,912
IP Out Delta (Tx Solution – Generation Solution)	**(50)**	**(46)**	**(1,106)**	**(1,102)**

III.C. Benefit-Cost Analysis Results: Indian Point Retirement

Net Increase in Tx Value with IP Retirement

Societal value of Tx portfolios increase in the Indian Point retirement scenario. Compared to the value of Tx with IP in:

Scenario	Production Costs (NPV $m)
"Scenario A" – IP in, with Tx	$38,583
"Scenario B" – IP out, with Tx	$46,444
"Scenario C" – IP in, no Tx	$39,129
"Scenario D" – IP out, no Tx	$47,194
Production Cost Savings of Tx with IP: Scenario A – Scenario C	**$547**
Production Cost Savings of Tx without IP: Scenario B – Scenario D	**$749**
Higher Production Cost Savings Value of Line if IP Retires	**$202**

- Production cost savings by Tx will *increase* by $202m without IP
- Capacity cost savings *increase* by $380–480m in NPV (depending on the project) due to short-term need for capacity in SENY; transmission allows delay and shift to UPNY
- Net impact for the Tx portfolio (using P14 as a representative)* is an increase in NPV of $680m (increases B:C ratio to 1.6)

**Note*: This analysis shows only P14 under an IP retirement scenario. The value of other portfolios likely to increase by a similar amount w/IP retirement.

Contents

III.D. Benefit-Cost Analysis Results: Benefits by Project

P6 NYTO

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $631m	**PVRR = -$887m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $8m in 2019; $17m in 2024 Multiplier for Other Factors = 1.6x	**$221m**	-$67m with lower 1.2x multiplier to +$28m with 1% real escalation
Avoided Transmission Costs	See later slides	**$281m**	-$53m if Refurbishment Required 10 Years Later in the Base Case +$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 1017 MW in G-J, 213 MW in J, 125 MW in K Resource Cost Svgs = $15m in 2019; $25m in 2024 Variant 1 = $18m in 2019; $28m in 2024 Variant 2 = $139m in 2019; $164m in 2024	**Resource Cost Svgs = $284m** Variant 1 = $306m Variant 2 = $857m	-$157m if 2,000 MW retires in UPNY to +$438m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $0.3/MWh in 2019, $0.4/MWh in 2024 Saves: $0.6m in 2019; $2.3m in 2024	**$27m**	-$17m to just meet 2024 RPS to +$22m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$7m in 2019; $8m in 2024	**$142m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$68m** **B/C Ratio = 1.1**	
Annual Emissions Impacts	Total System CO_2: -0.01 % in 2019; 0.02 % in 2024 Total System NO_x: -0.05% in 2019; -0.02 % in 2024 Total System SO_2: -0.5% in 2019; 0.23 % in 2024	NYCA CO_2: -0.51 % in 2019; -0.28 % in 2024 NYCA NO_x: -0.42% in 2019; -1.49 % in 2024 NYCA SO_2: -3.21% in 2019; -1.59 % in 2024	
Employment During Construction	4200 FTE (60% direct; 40% indirect and induced)		
Retirement Preparedness	Able to accommodate 1140 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*		

III.D. Benefit-Cost Analysis Results: Benefits by Project

P7 NYTO

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $361m	**PVRR = -$508m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $7m in 2019; $15m in 2024 Multiplier for Other Factors = 1.6x	**$194m**	-$59m with lower 1.2x multiplier to +$24m with 1% real escalation
Avoided Transmission Costs	See later slides	**$70m**	N/A
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 911 MW in G-J, 209 MW in J, 123 MW in K Resource Cost Svgs = $15m in 2019; $25m in 2024 Variant 1 = $18m in 2019; $29m in 2024 Variant 2 = $138m in 2019; $168m in 2024	**Resource Cost Svgs = $284m** Variant 1 = $305m Variant 2 = $876m	-$157m if 2,000 MW retires in UPNY to +$384m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $0.3/MWh in 2019, $0.5/MWh in 2024 Saves: $0.7m in 2019; $2.7m in 2024	**$31m**	-$19m to just meet 2024 RPS to +$26m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$4m in 2019; $5m in 2024	**$104m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$175m** **B/C Ratio = 1.3**	
Annual Emissions Impacts	Total System CO2: -0.02 % in 2019; -0.01 % in 2024 Total System NOx: -0.02% in 2019; 0.01 % in 2024 Total System SO2: -0.26% in 2019; -0.34 % in 2024	NYCA CO2: -0.3 % in 2019; -0.05 % in 2024 NYCA NOx: -0.25% in 2019; -1.01 % in 2024 NYCA SO2: -1.55% in 2019; -1.72 % in 2024	
Employment During Construction	2400 FTE (60% direct; 40% indirect and induced)		
Retirement Preparedness	Able to accommodate 1030 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*		

III.D. Benefit-Cost Analysis Results: Benefits by Project

P9 NYTO

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $631m	**PVRR = -$887m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $9m in 2019; $20m in 2024 Multiplier for Other Factors = 1.6x	**$262m**	-$80m with lower 1.2x multiplier to +$32m with 1% real escalation
Avoided Transmission Costs	See later slides	**$260m**	-$45m if Refurbishment Required 10 Years Later in the Base Case +$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 932 MW in G-J, 213 MW in J, 125 MW in K Resource Cost Svgs = $15m in 2019; $25m in 2024 Variant 1 = $18m in 2019; $28m in 2024 Variant 2 = $140m in 2019; $167m in 2024	**Resource Cost Svgs = $286m** Variant 1 = $307m Variant 2 = $869m	-$157m if 2,000 MW retires in UPNY to +$394m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $0.4/MWh in 2019, $0.7/MWh in 2024 Saves: $0.9m in 2019; $3.6m in 2024	**$41m**	-$26m to just meet 2024 RPS to +$34m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$7m in 2019; $8m in 2024	**$151m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$114m** **B/C Ratio = 1.1**	
Annual Emissions Impacts	Total System CO_2: -0.01 % in 2019; -0.01 % in 2024 Total System NOx: -0.02% in 2019; -0.07 % in 2024 Total System SO_2: -0.43% in 2019; -0.12 % in 2024	NYCA CO_2: -0.47 % in 2019; -0.12 % in 2024 NYCA NOx: -0.31% in 2019; -1.16 % in 2024 NYCA SO_2: 0.82% in 2019; -0.99 % in 2024	
Employment During Construction	4200 FTE (60% direct; 40% indirect and induced)		
Retirement Preparedness	Able to accommodate 1060 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*		

III.D. Benefit-Cost Analysis Results: Benefits by Project

P11 NYTO

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = \$1189m	**PVRR = -\$1671m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: \$28m in 2019; \$36m in 2024 Multiplier for Other Factors = 1.6x	**\$516m**	-\$157m with lower 1.2x multiplier to +\$60m with 1% real escalation
Avoided Transmission Costs	See later slides	**\$998m**	-\$352m if Refurbishment Required 10 Years Later in the Base Case +\$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 1087 MW in G-J, 217 MW in J, 127 MW in K Resource Cost Svgs = \$15m in 2019; \$25m in 2024 Variant 1 = \$18m in 2019; \$28m in 2024 Variant 2 = \$141m in 2019; \$167m in 2024	**Resource Cost Svgs = \$286m** Variant 1 = \$309m Variant 2 = \$883m	-\$159m if 2,000 MW retires in UPNY to +\$469m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: \$1.4/MWh in 2019, \$1.6/MWh in 2024 Saves: \$3.4m in 2019; \$8.3m in 2024	**\$97m**	-\$61m to just meet 2024 RPS to +\$80m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	\$14m in 2019; \$15m in 2024	**\$151m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +\$377m** **B/C Ratio = 1.2**	
Annual Emissions Impacts	Total System CO_2: 0.02 % in 2019; -0.02 % in 2024 Total System NO_x: 0.09% in 2019; -0.04 % in 2024 Total System SO_2: -0.27% in 2019; 0.02 % in 2024	NYCA CO_2: -0.65 % in 2019; -0.25 % in 2024 NYCA NO_x: 0.19% in 2019; -0.98 % in 2024 NYCA SO_2: 3.96% in 2019; 0.4 % in 2024	
Employment During Construction	7800 FTE (60% direct; 40% indirect and induced)		
Retirement Preparedness	Able to accommodate 1210 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*		

III.D. Benefit-Cost Analysis Results: Benefits by Project

P12 NYTO

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = \$1090m	**PVRR = -\$1533m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: \$30m in 2019; \$39m in 2024 Multiplier for Other Factors = 1.6x	**\$554m**	-\$168m with lower 1.2x multiplier to +\$64m with 1% real escalation
Avoided Transmission Costs	See later slides	**\$873m**	-\$286m if Refurbishment Required 10 Years Later in the Base CaseN/A
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 1079 MW in G-J, 217 MW in J, 127 MW in K Resource Cost Svgs = \$15m in 2019; \$25m in 2024 Variant 1 = \$18m in 2019; \$28m in 2024 Variant 2 = \$141m in 2019; \$168m in 2024	**Resource Cost Svgs = \$286m** Variant 1 = \$308m Variant 2 = \$894m	-\$158m if 2,000 MW retires in UPNY to +\$465m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: \$1.6/MWh in 2019, \$1.8/MWh in 2024 Saves: \$3.8m in 2019; \$9.2m in 2024	**\$108m**	-\$67m to just meet 2024 RPS to +\$89m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	\$13m in 2019; \$14m in 2024	**\$163m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +\$451m** **B/C Ratio = 1.3**	
Annual Emissions Impacts	Total System CO2: 0.04 % in 2019; -0.03 % in 2024 Total System NOx: 0.05% in 2019; -0.1 % in 2024 Total System SO2: -0.18% in 2019; -0.45 % in 2024	NYCA CO2: -0.75 % in 2019; -0.07 % in 2024 NYCA NOx: 0.26% in 2019; -0.64 % in 2024 NYCA SO2: 3.07% in 2019; 0.18 % in 2024	
Employment During Construction	7200 FTE (60% direct; 40% indirect and induced)		
Retirement Preparedness	Able to accommodate 1210 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*		

III.D. Benefit-Cost Analysis Results: Benefits by Project

P14 NYTO

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $1218m	**PVRR = -$1713m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $30m in 2019; $39m in 2024 Multiplier for Other Factors = 1.6x	**$547m**	-$166m with lower 1.2x multiplier to +$63m with 1% real escalation
Avoided Transmission Costs	See later slides	**$995m**	-$336m if Refurbishment Required 10 Years Later in the Base Case +$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 1107 MW in G-J, 217 MW in J, 127 MW in K Resource Cost Svgs = $15m in 2019; $25m in 2024 Variant 1 = $18m in 2019; $28m in 2024 Variant 2 = $141m in 2019; $168m in 2024	**Resource Cost Svgs = $286m** Variant 1 = $309m Variant 2 = $896m	-$159m if 2,000 MW retires in UPNY to +$478m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $1.6/MWh in 2019, $1.8/MWh in 2024 Saves: $3.7m in 2019; $9.2m in 2024	**$108m**	-$67m to just meet 2024 RPS to +$88m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$14m in 2019; $15m in 2024	**$169m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$392m** **B/C Ratio = 1.2**	

Annual Emissions Impacts	Total System CO2: 0.03 % in 2019; -0.02 % in 2024 Total System NOx: 0.03% in 2019; -0.01 % in 2024 Total System SO2: -0.29% in 2019; 0.01 % in 2024	NYCA CO2: -0.87 % in 2019; -0.11 % in 2024 NYCA NOx: -0.11% in 2019; -0.77 % in 2024 NYCA SO2: 0.83% in 2019; 1.52 % in 2024
Employment During Construction	8000 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1230 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

III.D. Benefit-Cost Analysis Results: Benefits by Project

P19a NextEra

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = \$461m	**PVRR = -\$648m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: \$8m in 2019; \$17m in 2024 Multiplier for Other Factors = 1.6x	**\$221m**	-\$67m with lower 1.2x multiplier to +\$28m with 1% real escalation
Avoided Transmission Costs	See later slides	**\$264m**	-\$86m if Refurbishment Required 10 Years Later in the Base Case +\$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 935 MW in G-J, 213 MW in J, 125 MW in K Resource Cost Svgs = \$15m in 2019; \$25m in 2024 Variant 1 = \$18m in 2019; \$28m in 2024 Variant 2 = \$139m in 2019; \$164m in 2024	**Resource Cost Svgs = \$285m** Variant 1 = \$305m Variant 2 = \$839m	-\$156m if 2,000 MW retires in UPNY to +\$397m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: \$0.3/MWh in 2019, \$0.4/MWh in 2024 Saves: \$0.6m in 2019; \$2.3m in 2024	**\$27m**	-\$17m to just meet 2024 RPS to +\$22m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	\$5m in 2019; \$6m in 2024	**\$87m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +\$236m** **B/C Ratio = 1.4**	

Annual Emissions Impacts	Total System CO2: -0.01 % in 2019; 0.02 % in 2024 Total System NOx: -0.05% in 2019; -0.02 % in 2024 Total System SO2: -0.5% in 2019; 0.23 % in 2024	NYCA CO2: -0.51 % in 2019; -0.28 % in 2024 NYCA NOx: -0.42% in 2019; -1.49 % in 2024 NYCA SO2: -3.21% in 2019; -1.59 % in 2024
Employment During Construction	3000 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1060 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

III.D. Benefit-Cost Analysis Results: Benefits by Project

P20 Boundless

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $918m	**PVRR = -$1291m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $3m in 2019; $10m in 2024 Multiplier for Other Factors = 1.6x	**$128m**	-$39m with lower 1.2x multiplier to +$16m with 1% real escalation
Avoided Transmission Costs	See later slides	**$157m**	N/A
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 904 MW in G-J, 211 MW in J, 124 MW in K Resource Cost Svgs = $15m in 2019; $26m in 2024 Variant 1 = $18m in 2019; $29m in 2024 Variant 2 = $140m in 2019; $171m in 2024	**Resource Cost Svgs = $288m** Variant 1 = $308m Variant 2 = $894m	-$158m if 2,000 MW retires in UPNY to +$380m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $0.1/MWh in 2019, $0.3/MWh in 2024 Saves: $0.3m in 2019; $1.5m in 2024	**$17m**	-$11m to just meet 2024 RPS to +$14m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$11m in 2019; $12m in 2024	**$264m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = -$436m** **B/C Ratio = 0.7**	

Annual Emissions Impacts	Total System CO_2: -0.02 % in 2019; 0 % in 2024 Total System NO_x: -0.01% in 2019; -0.03 % in 2024 Total System SO_2: -0.21% in 2019; -0.18 % in 2024	NYCA CO_2: -0.21 % in 2019; 0.27 % in 2024 NYCA NO_x: -0.18% in 2019; -0.61 % in 2024 NYCA SO_2: -0.27% in 2019; 0.26 % in 2024
Employment During Construction	6100 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1030 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

III.D. Benefit-Cost Analysis Results: Benefits by Project

P21 Boundless

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $671m	**PVRR = -$944m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $3m in 2019; $9m in 2024 Multiplier for Other Factors = 1.6x	**$115m**	-$35m with lower 1.2x multiplier to +$15m with 1% real escalation
Avoided Transmission Costs	See later slides	**$76m**	N/A
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 895 MW in G-J, 211 MW in J, 124 MW in K Resource Cost Svgs = $15m in 2019; $26m in 2024 Variant 1 = $18m in 2019; $29m in 2024 Variant 2 = $140m in 2019; $171m in 2024	**Resource Cost Svgs = $288m** Variant 1 = $308m Variant 2 = $892m	-$157m if 2,000 MW retires in UPNY to +$375m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $0.2/MWh in 2019, $0.3/MWh in 2024 Saves: $0.4m in 2019; $1.5m in 2024	**$17m**	-$11m to just meet 2024 RPS to +$14m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$8m in 2019; $8m in 2024	**$193m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = -$254m** **B/C Ratio = 0.7**	

Annual Emissions Impacts	Total System CO_2: -0.01 % in 2019; -0.05 % in 2024 Total System NO_x: -0.02% in 2019; -0.03 % in 2024 Total System SO_2: -0.24% in 2019; -0.02 % in 2024	NYCA CO_2: -0.15 % in 2019; 0.25 % in 2024 NYCA NO_x: -0.13% in 2019; -0.53 % in 2024 NYCA SO_2: -0.4% in 2019; 2.18 % in 2024
Employment During Construction	4400 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1020 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

REV Resources Benefit-Cost Analysis

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $2629m	**PVRR = -$2156m**	N/A
Production Cost Savings, including multiplier (model vs. futures LBMPs)	MAPS: $208m in 2019; $331m in 2024 Multiplier for Other Factors = 1.03x in Zones GHI, 1.06x in Zone J	**$1943m**	-$259m if EE capacity factor is reduced to 65%to + $90m if based on load-weighted average LMP
Avoided Transmission Costs	None	N/A	N/A
Capacity Resource Cost Savings from avoided new construction	Resource Cost Svgs = $57m in 2019; $91m in 2024 Variant 1 = $67MM in 2019; $107MM in 2024 Variant 2 = $440MM in 2019; $649MM in 2024	**Resource Cost Svgs = $613m** Variant 1 = $692m Variant 2 = $3468m	$136m if 2,000 MW retires in UPNY to +$393m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	None	N/A	N/A
Tax Receipts from property tax and state income tax in RevReq	None	N/A	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$400m** **B/C Ratio = 1.2**	
Annual Emissions Impacts	NYCA CO2: -1,231 thousand tons in 2019; -1,538 thousand tons in 2024 NYCA NOx: -1,438 tons in 2019; - 1,797 tons in 2024 NYCA SO2: -1,725 tons in 2019; -2,157 tons in 2024		
Employment During Construction	2000 to 16000 FTE (4% to 80% direct, depending on type of measure)		
Retirement Preparedness	Able to accommodate 1200 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Market Benefits, Storm Resiliency, Relieving Gas Transport Constraints *(see following slides)*		

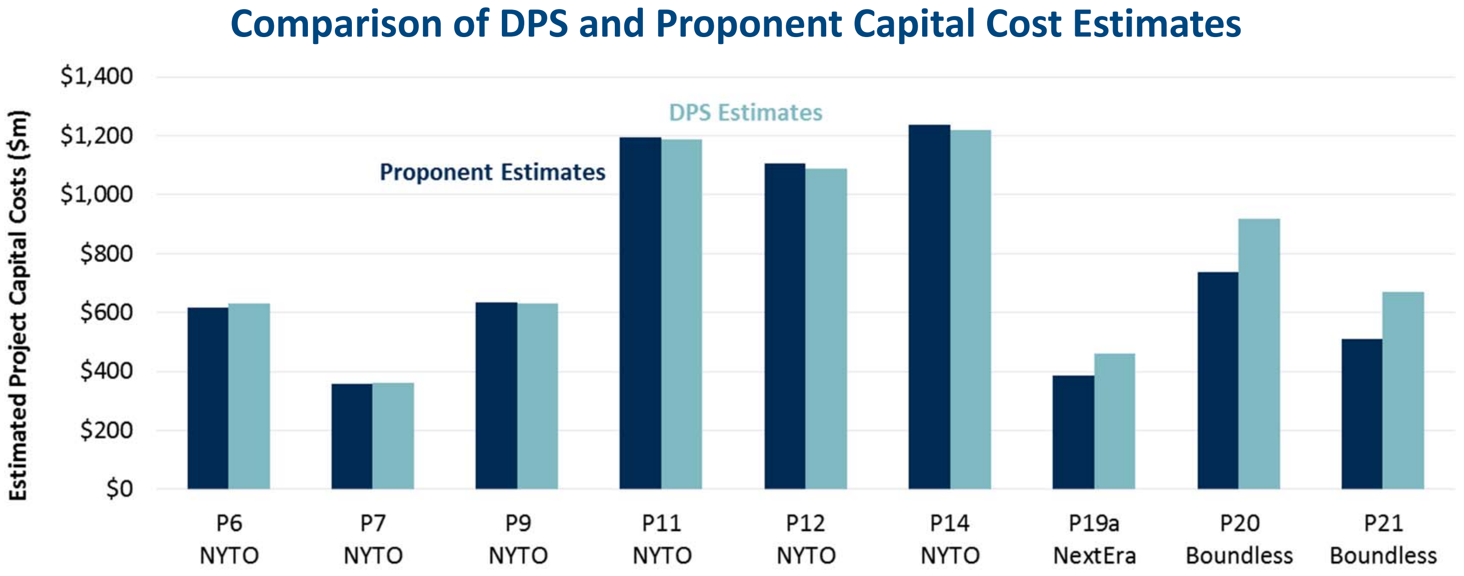
Note: Emissions reductions based on REV GEIS.

Contents

Estimated Overnight Capital Costs

DPS staff developed two capital cost estimates for each Tx portfolio based on their analysis of the project components ("DPS Estimates") and a review of proponent cost estimates ("Proponent Estimates")

- Cost estimates represent overnight capital costs as of mid-2015
- We calculated NPV and B:C ratio using both cost estimates on slides 14 and 15
- All other analyses in this report use the DPS Estimates



Translating Costs to Revenue Requirements

DPS provided workbook to estimate 45-year RevReq for $100m capital investment

- Workbook calculates annual revenue requirements beginning in Year-1 (assume in-service date of Jan 2019 and total 2019 revenues received at mid-year on average), based on investment costs as of Year-0 (as of mid-2018)
- Discounting annual RevReq at 9.13% (as requested by DPS) yields a Year-0 PVRR of 1.65x the Year-0 capital investment costs
- See next slide for treatment of cost escalation, interest during construction, and discounting
- There is significant uncertainty in RevReq calculation due to assumptions required in developing actual project costs and the assumed FERC ROE (8.7% in DPS analysis)

AC Transmission Upgrade Case 12-T-0502 et al.
Analysis of Revenue Requirement needed assuming $100 M Investment

Investment	$ 100,000,000		Rate of Inflation	2.00%
PTROR (w/adder)	9.97%			
Depreciation Rate	2.26%	(44.25 years)		
Property Tax	2.18%			

MULTIPLIER FACTOR	
Investment	Total Cost PV
$1=	$1.65
Discount Rate:	9.13%

	O&M, Property Taxes and Depreciation Expense				Rate Base								
Year	O&M Exp - Transmission	Property Taxes	Book Depreciation	Total Exp	Initial Investment	Accumulated Depreciation	Net Plant	AVG Net Plant	Deferred Tax	Prepayments, M&S Working Capital	Rate Base	Return on Investment	Revenue Requirement
1	2,861,617	2,183,334	2,260,000	7,304,951	100,000,000	2,260,000	97,740,000	98,870,000	298,000	1,786,641	100,358,641	10,005,757	17,310,707
2	2,918,849	2,227,001	2,260,000	7,405,850	100,000,000	4,520,000	95,480,000	96,610,000	1,587,800	1,793,796	96,815,996	9,652,555	17,058,404
3	2,977,226	2,271,541	2,260,000	7,508,767	100,000,000	6,780,000	93,220,000	94,350,000	3,463,000	1,801,093	92,688,093	9,241,003	16,749,770
4	3,036,770	2,316,972	2,260,000	7,613,742	100,000,000	9,040,000	90,960,000	92,090,000	5,129,800	1,808,536	88,768,736	8,850,243	16,463,985
5	3,097,506	2,363,311	2,260,000	7,720,817	100,000,000	11,300,000	88,700,000	89,830,000	6,603,800	1,816,128	85,042,328	8,478,720	16,199,537
6	3,159,456	2,410,577	2,260,000	7,830,033	100,000,000	13,560,000	86,440,000	87,570,000	7,899,400	1,823,871	81,494,471	8,124,999	15,955,032
7	3,222,645	2,458,789	2,260,000	7,941,434	100,000,000	15,820,000	84,180,000	85,310,000	9,030,000	1,831,770	78,111,770	7,787,743	15,729,177
8	3,287,098	2,507,965	2,260,000	8,055,063	100,000,000	18,080,000	81,920,000	83,050,000	10,008,000	1,839,827	74,881,827	7,465,718	15,520,781
9	3,352,840	2,558,124	2,260,000	8,170,964	100,000,000	20,340,000	79,660,000	80,790,000	10,900,800	1,848,044	71,737,244	7,152,203	15,323,167
10	3,419,897	2,609,286	2,260,000	8,289,183	100,000,000	22,600,000	77,400,000	78,530,000	11,781,400	1,856,426	68,605,026	6,839,921	15,129,104
11	3,488,295	2,661,472	2,260,000	8,409,767	100,000,000	24,860,000	75,140,000	76,270,000	12,662,000	1,864,976	65,472,976	6,527,656	14,937,422
12	3,558,061	2,714,701	2,260,000	8,532,762	100,000,000	27,120,000	72,880,000	74,010,000	13,542,600	1,873,697	62,341,097	6,215,407	14,748,169
13	3,629,222	2,768,995	2,260,000	8,658,217	100,000,000	29,380,000	70,620,000	71,750,000	14,423,200	1,882,592	59,209,392	5,903,176	14,561,394
14	3,701,806	2,824,375	2,260,000	8,786,182	100,000,000	31,640,000	68,360,000	69,490,000	15,303,800	1,891,665	56,077,865	5,590,963	14,377,145
15	3,775,842	2,880,863	2,260,000	8,916,705	100,000,000	33,900,000	66,100,000	67,230,000	16,184,400	1,900,920	52,946,520	5,278,768	14,195,473
16	3,851,359	2,938,480	2,260,000	9,049,839	100,000,000	36,160,000	63,840,000	64,970,000	17,065,000	1,910,359	49,815,359	4,966,591	14,016,431
17	3,928,386	2,997,250	2,260,000	9,185,636	100,000,000	38,420,000	61,580,000	62,710,000	17,945,600	1,919,988	46,684,388	4,654,433	13,840,070
18	4,006,954	3,057,195	2,260,000	9,324,149	100,000,000	40,680,000	59,320,000	60,450,000	18,826,200	1,929,809	43,553,609	4,342,295	13,666,444
19	4,087,093	3,118,339	2,260,000	9,465,432	100,000,000	42,940,000	57,060,000	58,190,000	19,706,800	1,939,826	40,423,026	4,030,176	13,495,608
20	4,168,835	3,180,705	2,260,000	9,609,541	100,000,000	45,200,000	54,800,000	55,930,000	20,587,400	1,950,044	37,292,644	3,718,077	13,327,617

Sources and notes: Figure illustrates first 20 years from AC Transmission Revenue Requirement Spreadsheet provided by DPS .

IV.A. AC Transmission Cost Estimates

Cost Escalation, AFUDC, and Discounting

Calculated the present value of the revenue requirements (PVRR) based on the 2015 overnight capital costs provided by DPS, using the following approach:

1. Calculate Total Investment Costs as of mid-2018:
   a) Assuming construction occurs in 2017 and 2018 with costs occurring in Jan 2018 on average, escalate mid-2015 overnight capital costs 2.5 years to Jan 2018 at 2.4% per year (0.4% above inflation);
   b) Then add one year of AFUDC at 9.13% to calculate total investment costs as of Jan 2019 in-service date;
   c) Finally, discount 0.5 year back to mid-2018 to be consistent with DPS RevReq analysis on prior slide;
   d) <u>Results in total investment costs as of mid-2018 being 1.11x the mid-2015 overnight costs</u>
2. Convert mid-2018 investment costs to mid-2018 PVRR using 1.65x PVRR multiplier from prior slide
3. Discount mid-2018 PVRR to mid-2015 PVRR 3 years at DPS's 9.13%; results in a discount factor of 0.77

Overall ratio of PVRR in 2015$ to Overnight Capital Costs in 2015$ is 1.41

Portfolios	Overnight Costs as of Mid-2015 (2015 $m)		Investment Costs as of Mid-2018 (2018 $m)		PVRR as of Mid-2018 (2018 $m)		PVRR as of Mid-2015 (2015 $m)
P6 NYTO	$631	x1.11	$700	x1.65	$1,153	x0.77	$887
P7 NYTO	$361	x1.11	$400	x1.65	$660	x0.77	$508
P9 NYTO	$631	x1.11	$699	x1.65	$1,153	x0.77	$887
P11 NYTO	$1,189	x1.11	$1,318	x1.65	$2,172	x0.77	$1,671
P12 NYTO	$1,090	x1.11	$1,208	x1.65	$1,992	x0.77	$1,533
P14 NYTO	$1,218	x1.11	$1,350	x1.65	$2,226	x0.77	$1,713
P19a NextEra	$461	x1.11	$511	x1.65	$842	x0.77	$648
P20 Boundless	$918	x1.11	$1,017	x1.65	$1,677	x0.77	$1,291
P21 Boundless	$671	x1.11	$744	x1.65	$1,227	x0.77	$944

Contents

Generation Costs

Variable costs: Assume 7,000 Btu/kWh heat rate and $7.01/MWh VOM (2019$)

Capital and fixed O&M costs: Utilized analysis completed for NYISO 2013 Demand Curve Reset (DCR) for estimating the capital and annual fixed O&M costs of the generation solution

- In the 2013 DCR, the estimated capital costs of a 311 MW Combined Cycle plant in Zone G is $501m, or **$1,573/kW** (grossed up to 2015$)
- We assume an equivalent per-kW cost for the 1,320 MW generation solution, which results in **capital costs of $2,077m** (includes $69m for gas/electric interconnection)
- Fixed O&M costs are assumed to be equivalent to DCR at **$51/kW-yr** or $67 million/yr
- Assuming utility-based cost of capital under a PPA, we calculate **PVRR of $3,332m** over 25-year economic life assumed in DCR (and evaluate benefits over the same time)

Alternative 45-Year case: Assume fixed O&M costs continue at the same annual rate (although they would be expected to increase) for an additional 20 years

Source: NERA, Independent Study to Establish Parameters of the ICAP Demand Curve for the New York Independent System Operator, August 2, 2013.

REV Resource Costs

Using unit total resource costs from the GEIS analysis, we estimate capital costs of REV portfolio to be $2,629m

- GEIS cost estimates represents the total resource costs, including initial and ongoing costs, which we assume are incurred in the year the resource is installed
- 60% of costs are assumed to be utility programs costs, remaining 40% paid by customers

REV costs in GEIS may be optimistic, but in any case are uncertain

- Assumes statewide average EE costs can be improved to match best-performing utilities and sectors from 2013
- Assumes effectiveness of future spending on EE measures will increase by 10 – 20%

REV Resource	Capacity (MW)	Costs ($/kW)	Costs ($m)
Energy Efficiency	838 MW	$2,100	$1,771
Customer-Sited Renewables	73 MW	$8,600	$627
Demand Response	89 MW	$600	$55
Combined Heat & Power	28 MW	$3,800	$105
Rate Structure	117 MW	---	---
Grid Integrated Vehicles	15 MW	$600	$10
Storage	40 MW	$1,500	$61
Total	**1,200 MW**	**---**	**$2,629**

Source: REV GEIS. See next slide for sources supporting resource distribution and economic life estimates.

REV Sources

REV Resource Distribution

- Final Generic Impact Statement in Case 14-M-0101 – Reforming the Energy Vision and Case 14-M-0094 – Clean Energy Fund
- NYSERDA Energy Efficiency and Renewable Energy Potential Study of New York State (EE)
- 2015 Gold Book Draft Long-Term Forecast (EE, solar PV, fossil fuel DG, grid-integrated vehicles, storage)
- NYISO Power Trends 2014 (DR and rate structures)
- U.S. DOE Combined Heat and Power Installation Database (CHP)

REV Resource Measure Life Estimates

- NYSERDA Energy Efficiency and Renewable Energy Potential Study of New York State (EE)
- PSCo DSG study; Min VOS Austin Energy and Minnesota VOS study; PacifiCorp VOS (solar PV)
- http://www.brattle.com/system/publications/pdfs/000/005/013/original/Exploring_Natural_Gas_and_Renewables_in_ERCOT_Part_III_Shavel_Weiss_Fox-Pennerf.pdf?1401907416 (CHP)
- http://www.hybridcars.com/how-long-will-an-evs-battery-last/ (grid-integrated vehicles)
- http://www.brattle.com/system/news/pdfs/000/000/749/original/The_Value_of_Distributed_Electricity_Storage_in_Texas.pdf (storage)
- http://www.emfwise.com/smartmeters.php (rate structures - typical life span of smart meters)

Summary of Cost Estimates

Tx Solution	Added Capacity or STE Transfer Limit Impact into SENY (MW)*	Estimated Capital Cost (2015 $m)	Estimated Capital Cost ($/kW)	Estimated PVRR (2015 $m)
P6 NYTO	1,686	$631	$374	$887
P7 NYTO	1,404	$361	$257	$508
P9 NYTO	2,091	$631	$302	$887
P11 NYTO	1,621	$1,189	$733	$1,671
P12 NYTO	1,341	$1,090	$813	$1,533
P14 NYTO	2,286	$1,218	$533	$1,713
P19a NextEra	1,747	$461	$264	$648
P20 Boundless	1,753	$918	$524	$1,291
P21 Boundless	1,433	$671	$469	$944
Generation (25 years)	1,320	$2,077	$1,573	$3,332
Generation (45 years)	1,320	$2,077	$1,573	$3,473
REV Resources	1,200	$2,629	$2,191	$2,156

Contents

Overview of MAPS Analysis

Quantify impact of each solution on **production costs, LBMPs,** and **emissions** in 2019 and 2024 and use results to interpolate impacts in 2020 – 2023 and to extrapolate impacts to 2063

- **Base Case:** Reflects the business-as-usual view of the future with currently forecasted load growth, no unplanned additions or retirements, fuel prices corresponding to futures, and Athens SPS expiring in 2024
- **Change Case**
  - For Tx and Generation, adjust the Base Case in MAPS by adding either one of the Tx portfolios or generic generation
  - Athens SPS expires in 2019 for Tx Change Cases (not in Gen case)
  - For REV, we did not run a separate case in MAPS but calculated production cost savings based on the average LBMPs from our MAPS Base Case (savings likely to be trivially smaller if ran in MAPS and observed slight price decrease)
- **Scenarios and sensitivities**
  - Limited time in this study for other scenarios to capture value of solutions due to uncertainty in Tx and generation outages, load forecasts, and real-time conditions
  - We partly addressed through production cost savings “multipliers” discussed further in the next section
  - Analyzed three Indian Point retirement cases

Development of MAPS Base Case

Started with the most recent CARIS and input received from NYISO

- The starting point for developing the 2019 and 2024 Base Cases for our analysis was the Base Case from the 2013 CARIS
- NYISO adjusted generation capacity from 2014 Gold Book based on recent announcements concerning CPV Valley (*added*), Danskammer (*added*), Ravenswood 3-4 (*added*), Binghamton Cogen (*added*), Astoria 20 (*added*), Ravenswood 3-3 (*mothballed*), Bowline 2 (*uprated*), Dunkirk (*repowered*), and addition of 1,000 MW wind by 2024 to meet RPS requirements
- Later slides refer to this case as the “NYISO Base Case”

We implemented additional changes to reflect the most up-to-date market information in the MAPS analysis to produce a “Brattle Base Case”

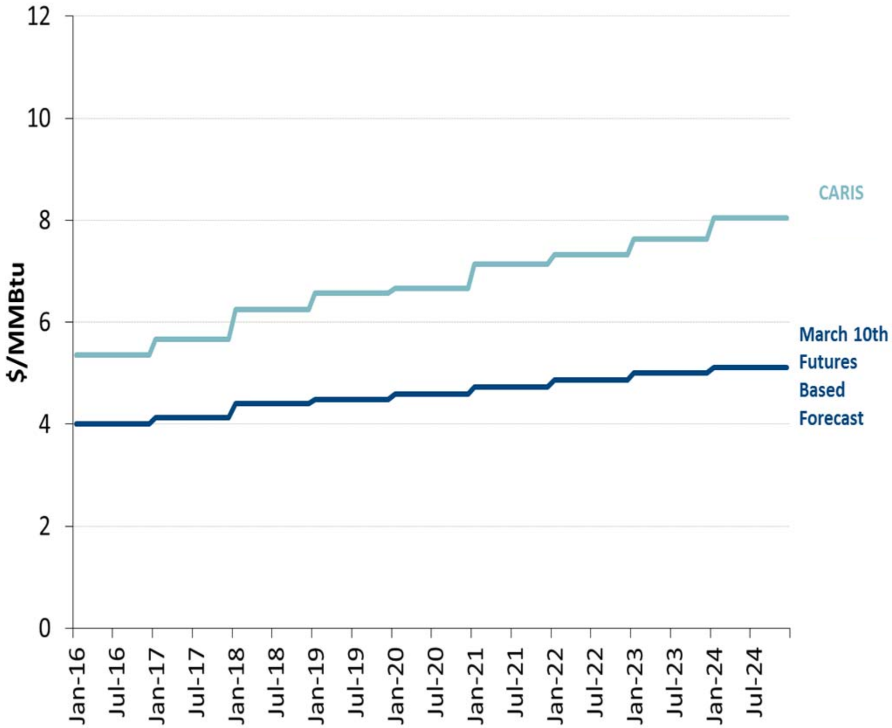
- Lower gas/oil prices consistent with current futures as of March 2015
  - Gas prices about \$2-3/MMBtu lower than 2013 CARIS assumptions
  - Oil prices about \$5-6/MMBtu lower than 2013 CARIS assumptions
  - No change to coal prices
- NYISO load forecast based on 2015 Gold Book, which is lower than 2014 Gold Book forecast by about 3% in 2019 and 2024
- Updated supply/demand in PJM, ISO-NE, and IESO, including the addition of 2 GW of CC/CT to PJM and 1 GW of CC/CT to ISO-NE

Natural Gas Price Input Assumptions

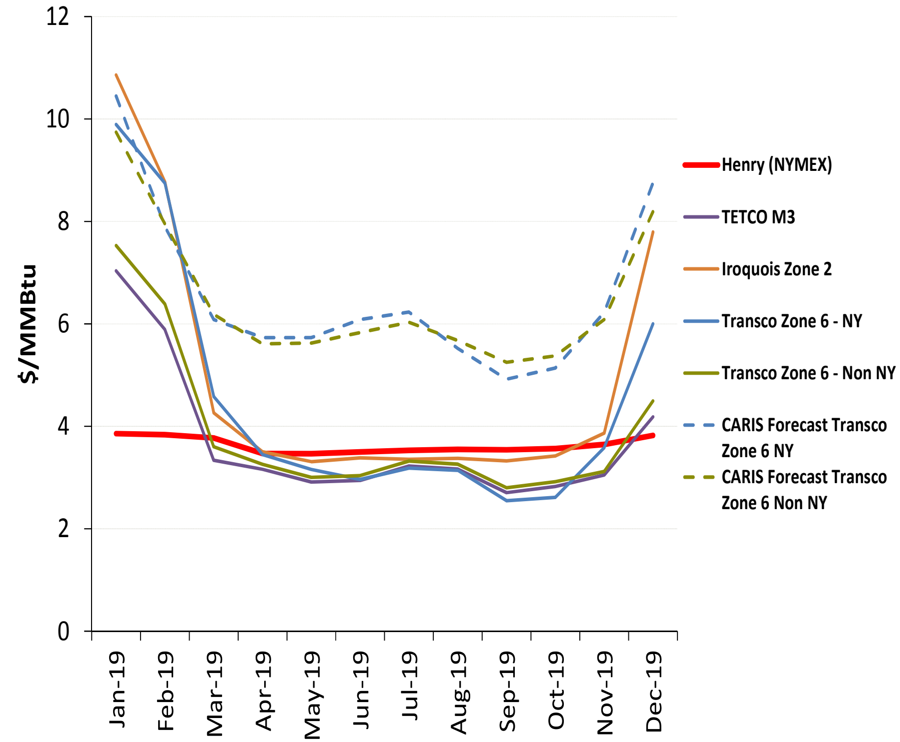
Natural Gas Price Forecasts

- Updated forecasts are consistent with current NYMEX and ICE futures (as of March 10, 2015)
- Updated prices are much lower but have more seasonality in basis differentials

Transco Zone 6 Forecast Comparison

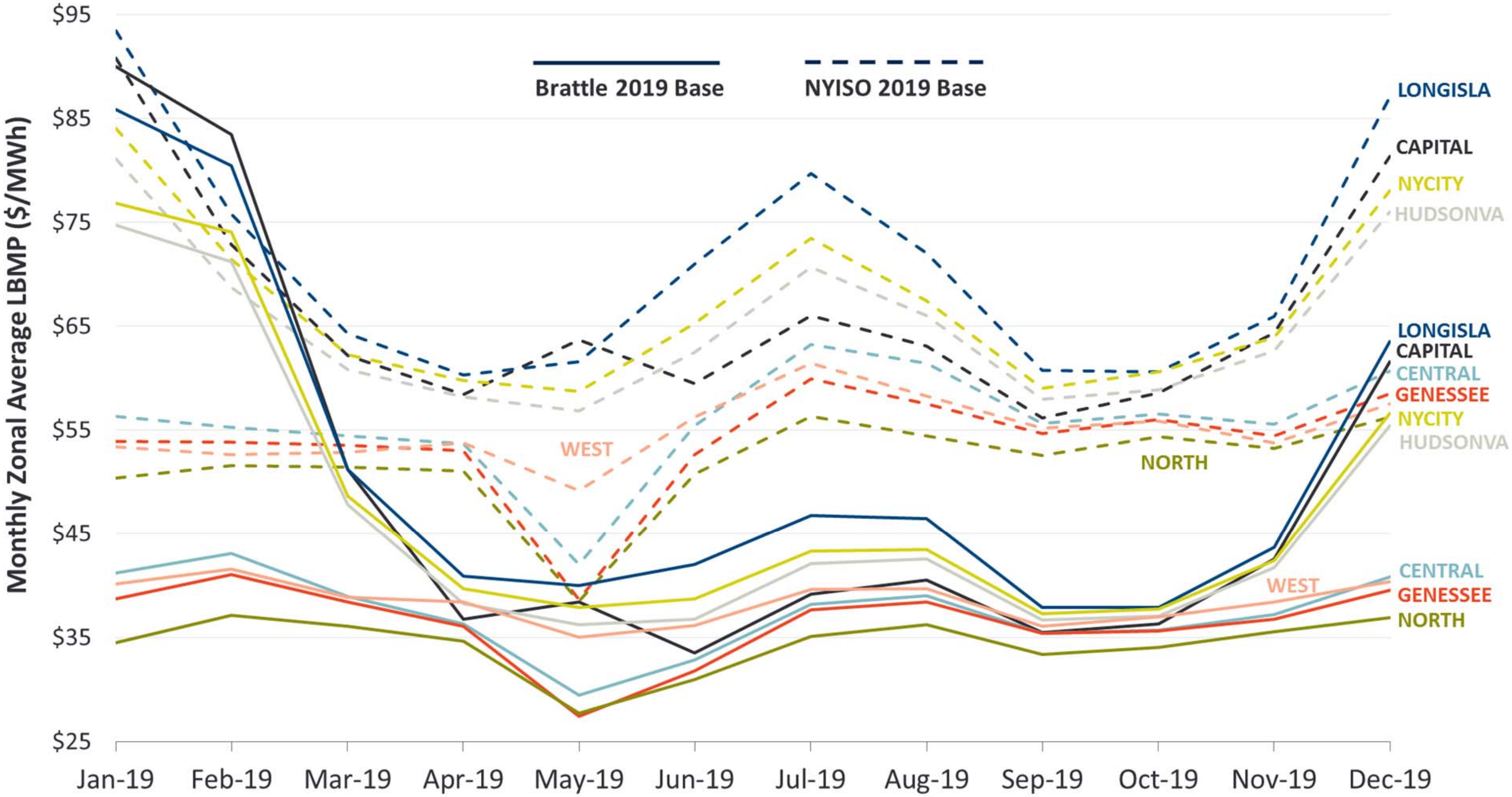


Updated 2019 NY Gas Forecasts



Source: Henry Hub Forecasts based on NYMEX data, all other hubs based on ICE data as of March 10, 2015

MAPS Monthly Average LBMPs in 2019



Source: Monthly Area Spot Price outputs NYISO 2019 Base Run and Brattle 2019 Base Run in MAPS

Notes: Prices for Dunwoodie (I), Hudson Valley (G), and Millwood (H) are closely aligned (both in the NYISO Base Run and Brattle Run 1). Only Hudson Valley is shown for the sake of clarity. Similarly, prices for Central (C) and Mohawk Valley (E) are closely aligned in both sets of outputs, so only Central is shown for the sake of clarity. The Brattle 2019 Base Case MAPS run shown here is without CPV Valley as it was completed in March 2015, prior to the CPV Valley announcement.

MAPS LBMPs Compared to Futures

NYISO Zonal LBMP Futures Compared to MAPS Runs ($/MWh)

Zone	NYMEX Futures: Contract Months 05/2015 - 04/2016	NYMEX Futures: Contract Months 05/2016 - 04/2017	NYMEX Futures: Contract Months 05/2017 - 04/2018	Brattle 2019 Base Run*
WEST - A	$36.7	$36.6	$35.9	$38.0
GENESSEE - B	-	-	-	$35.8
CENTRAL - C	$37.4	-	-	$36.8
NORTH - D	-	-	-	$34.3
MOHAWKVA - E	-	-	-	$36.5
CAPITAL - F	-	-	-	$47.0
HUDSONVA - G	$46.9	$46.5	$46.3	$44.6
MILLWOOD - H	-	-	-	$45.0
DUNWOODI - I	-	-	-	$44.9
NYCITY - J	$49.0	$48.6	$48.3	$45.5
LONGISLA - K	-	-	-	$48.8

Sources: NYMEX 5 MW Peak and Off-Peak Calendar Month Day-Ahead LMP Futures by NYISO zone (from SNL). Annual Average Area Spot Price outputs from MAPS, Brattle 2019 Base Run without CPV Valley .

Notes: The weighted average price is taken over futures contracts for the periods 5/2015 - 4/2016 (1-12 months forward), 5/2016 - 4/2017 (13-24 months forwards), and 5/2017 to 4/2018 (25-26 months forward) only if all contract months within the period are traded for a given zone, using prices from past 30 trade days. Weighted averages are taken using 48% on-peak and 52% off-peak prices.

* The Brattle 2019 Base Case MAPS run shown here is without CPV Valley. This is to maintain consistency with the NYMEX data from March 2015, our fuel price assumptions, and our development of production cost savings multipliers (see slides 84-87). CPV Valley announced its decision to enter the market on July 15, 2015, with an anticipated online date in early 2018. The NYMEX futures shown above would not likely account for any impact CPV Valley may have.

V.A.1. MAPS Analysis of Production Cost Saving: Base Case

Congestion Rents in Brattle vs. NYISO Base Case

Ranked by Brattle Congestion Rents

Constraints	2019 Brattle Base	2019 Delta to NYISO Base
CENTRAL EAST	306,077	48,883
HUNTLEY PACKARD	49,083	(16,019)
VOLNEY SCRIBA	29,874	(116,825)
DUNWOODIE SHORE ROAD	25,050	(2,673)
LEEDS PLEASANT VALLEY	23,587	(12,140)
Ramapo PAR	18,322	1,048
VLY STRM2 138.00-E.G.C.-2 138.00	9,816	(11,219)
GARDV230 230.00-STOLE230 230.00	5,614	5,491
GREENWOOD	5,150	(2,759)
BURNS138 138.00-WHAV138 138.00	2,500	1,018
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont	**1,371,739**	**(506,251)**

Ranked by Congestion Rent Differences

Constraints	2019 Brattle Base	2019 Delta to NYISO Base
CENTRAL EAST	306,077	48,883
GARDV230 230.00-STOLE230 230.00	5,614	5,491
NEW SCOTLAND LEEDS	2,185	2,185
CLAY 345.00-CLAY 115.00	71	(2,407)
DUNWOODIE SHORE ROAD	25,050	(2,673)
GREENWOOD	5,150	(2,759)
VLY STRM2 138.00-E.G.C.-2 138.00	9,816	(11,219)
LEEDS PLEASANT VALLEY	23,587	(12,140)
HUNTLEY PACKARD	49,083	(16,019)
VOLNEY SCRIBA	29,874	(116,825)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont	**1,371,739**	**(506,251)**

Note: The Brattle 2019 Base Case MAPS run listed here is without CPV Valley as it was completed in March 2015, prior to the CPV Valley announcement.

V.A.1. MAPS Analysis of Production Cost Savings: Base Case

Forecasted Congestion vs. Historical

Top Historical NYCA Constraints – Historical and Forecasted Congestion Rent

Rank	Constrained Path	Annual Congestion Rent ($m)												
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	**Historical Average**	2019	2024
1	CENTRAL EAST - VC	$24	$58	$177	$348	$128	$146	$105	$77	$318	$334	**$171**	$306	$295
2	NEW SCOTLAND PLEASANT VALLEY	$56	$133	$142	$228	$59	$75	$95	$41	$48	$16	**$89**	$26	$67
3	DUNWOODIE SHORE ROAD	$82	$124	$68	$47	$29	$40	$47	$49	$60	$33	**$58**	$25	$30
4	GREENWOOD VERNON	$9	$16	$15	$15	$25	$34	$30	$12	$27	$1	**$18**	$1	$1
5	FRESHKILLS WILLOWBROOK	$23	$25	$14	$32	$10	$18	$16	$14	$13	$1	**$17**	$3	$1
6	MOTTHAVEN RAINEY	$0	$0	$13	$76	$14	$8	$5	$1	$0	$0	**$12**	$2	$0
	Historical Top 6 Constraints Total	$193	$355	$429	$746	$266	$322	$297	$195	$466	$386	**$365**	$362	$394
	TCC Fund Annual Total	$737	$601	$577	$985	$380	$414	$406	$295	$661	$558	**$561**		
	Historical Top 6 Constraints % of Total	*26%*	*59%*	*74%*	*76%*	*70%*	*78%*	*73%*	*66%*	*71%*	*69%*	***66%***		

Sources: NYISO hourly DAM limiting constraint data (shadow prices) for 2005-2014. Line and interface limits, forecasted congestion rents MAPS. NYISO annual congestion data summaries for 2005-2014 (TCC Fund annual totals).

Fundamental reasons for lower congestion today and going forward relative to historical congestion:

- Downstate's efficient CCs capacity grew from ~1,000 MW 10 years ago to nearly 4,000 MW today
  - SENY no longer relies as heavily on old, inefficient steam turbines and combustion turbines
  - SENY not short on capacity (until 2025 in Zone J)
- Upstate no longer has as much baseload coal generation
  - 10 years ago, UPNY had ~3,000 MW capacity and ~17,000 GWh annual generation
  - More recently, this declined to ~1,500 MW capacity and ~4,500 GWh annual generation

Note: The Brattle 2019 Base Case MAPS run listed here is without CPV Valley as it was completed in March 2015, prior to the CPV Valley announcement.

Contents

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

P6 NYTO

Input Changes:

- Topology: add new lines from Knickerbocker to Pleasant Valley
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW with early SPS retirement
- Ratings increases on other lines binding in Base Case:
  - 2019 & 2024: CPV_VLY 345.00-ROCK TAV 345.00 increases 352 MW
- Central East limits: increase by 50 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
CENTRAL EAST	D/E/F	NE/F	304,699	11,839	283,680	13,803
HUNTLEY PACKARD	A	A	47,704	2,317	74,237	(6,391)
KNICKERBOCK 345.00-N.SCOT77 345.00	F	F	N/A	2,148	N/A	2,790
DUNWOODIE SHORE ROAD	I	K	27,558	687	31,945	2,728
Ramapo PAR	G	G	15,149	154	6,459	2,485
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(22)	36,663	(2,647)
CLAY 345.00-CLAY 115.00	C	C	280	(158)	3,317	(2,909)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,815)	18,288	(17,536)
VOLNEY SCRIBA	C	C	45,074	(18,742)	63,524	(34,038)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(34,375)	50,103	(44,283)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**(19,126)**	**1,953,340**	**(70,509)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.43	0.32	51.71	0.26
GENESSEE (B)	35.23	0.23	47.04	0.58
CENTRAL (C)	36.19	0.21	48.28	0.36
NORTH (D)	33.78	0.22	45.70	0.49
MOHAWKVA (E)	35.82	0.28	47.82	0.54
CAPITAL (F)	46.52	0.19	57.79	0.54
HUDSONVA (G)	44.23	(0.26)	56.54	(0.39)
MILLWOOD (H)	44.52	(0.21)	56.89	(0.39)
DUNWOODI (I)	44.47	(0.22)	56.92	(0.43)
NYCITY (J)	45.02	(0.15)	57.44	(0.35)
LONGISLA (K)	48.69	(0.10)	61.86	(0.03)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,511	(8)	4,277	(17)
Total System	29,736	(10)	41,023	(11)

Source: The Brattle Group analysis using MAPS

P7 NYTO

Input Changes:

- Topology: Leeds-PV reconductor
- Leeds-PV limit on existing line: pre-2024 limit increased by 523 MW
- Ratings increases on other lines binding in Base Case:
  - 2019 & 2024: CPV_VLY 345.00-ROCK TAV 345.00 increases 352 MW
- Central East limits: increase by 25 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
CENTRAL EAST	D/E/F	NE/F	304,699	9,237	283,680	7,295
NEW SCOTLAND LEEDS	F	F	878	4,925	1,438	11,190
HUNTLEY PACKARD	A	A	47,704	1,963	74,237	(3,036)
DUNWOODIE SHORE ROAD	I	K	27,558	1,115	31,945	2,383
Ramapo PAR	G	G	15,149	692	6,459	3,084
CLAY 345.00-CLAY 115.00	C	C	280	(208)	3,317	(2,892)
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(675)	36,663	(2,985)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,859)	18,288	(18,288)
VOLNEY SCRIBA	C	C	45,074	(13,987)	63,524	(23,713)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(33,481)	50,103	(43,587)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**(17,906)**	**1,953,340**	**(44,893)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.43	0.35	51.71	0.42
GENESSEE (B)	35.23	0.29	47.04	0.63
CENTRAL (C)	36.19	0.27	48.28	0.44
NORTH (D)	33.78	0.24	45.70	0.51
MOHAWKVA (E)	35.82	0.31	47.82	0.57
CAPITAL (F)	46.52	0.18	57.79	0.29
HUDSONVA (G)	44.23	(0.16)	56.54	(0.24)
MILLWOOD (H)	44.52	(0.09)	56.89	(0.19)
DUNWOODI (I)	44.47	(0.12)	56.92	(0.25)
NYCITY (J)	45.02	(0.05)	57.44	(0.21)
LONGISLA (K)	48.69	0.04	61.86	0.09

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,511	(7)	4,277	(15)
Total System	29,736	(5)	41,023	(11)

Source: The Brattle Group analysis using MAPS

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

P9 NYTO

Input Changes:

- Topology: add a third path from Leeds to PV, NS-Leeds reconductor
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW with early SPS retirement
- Ratings increases on other lines binding in Base Case:
  - 2019 & 2024: New Scotland Leeds increases 616 MW, CPV_VLY 345.00-ROCK TAV 345.00 increases 352 MW.
- Central East limits: increase by 50 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
CENTRAL EAST	D/E/F	NE/F	304,699	3,332	283,680	5,596
MOTTHAVEN RAINEY	J	J	1,456	1,577	345	611
HUNTLEY PACKARD	A	A	47,704	1,425	74,237	(5,833)
DUNWOODIE SHORE ROAD	I	K	27,558	1,320	31,945	3,148
Ramapo PAR	G	G	15,149	478	6,459	3,882
CLAY 345.00-CLAY 115.00	C	C	280	(215)	3,317	(2,957)
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(798)	36,663	(3,063)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,859)	18,288	(18,288)
VOLNEY SCRIBA	C	C	45,074	(15,204)	63,524	(23,376)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(33,076)	50,103	(41,431)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**(23,760)**	**1,953,340**	**(40,556)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.43	0.41	51.71	0.51
GENESSEE (B)	35.23	0.40	47.04	0.82
CENTRAL (C)	36.19	0.37	48.28	0.62
NORTH (D)	33.78	0.40	45.70	0.74
MOHAWKVA (E)	35.82	0.43	47.82	0.77
CAPITAL (F)	46.52	0.12	57.79	0.50
HUDSONVA (G)	44.23	(0.33)	56.54	(0.32)
MILLWOOD (H)	44.52	(0.29)	56.89	(0.31)
DUNWOODI (I)	44.47	(0.28)	56.92	(0.34)
NYCITY (J)	45.02	(0.18)	57.44	(0.28)
LONGISLA (K)	48.69	(0.09)	61.86	0.10

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,511	(9)	4,277	(20)
Total System	29,736	(18)	41,023	(18)

Source: The Brattle Group analysis using MAPS

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

P11 NYTO

Input Changes:

- Topology: new line from Edic to New Scotland; add new lines from Knickerbocker to Pleasant Valley
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW with early SPS retirement
- Rating increases on other lines binding in Base Case:
  - 2019 & 2024: CPV_VLY 345.00-ROCK TAV 345.00 increases 352 MW.
- Central East limits: increase by 375 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
NEW SCOTLAND LEEDS	F	F	878	4,892	1,438	6,465
KNICKERBOCK 345.00-N.SCOT77 345.00	F	F	N/A	2,261	N/A	3,475
DUNWOODIE SHORE ROAD	I	K	27,558	1,891	31,945	3,802
HUNTLEY PACKARD	A	A	47,704	592	74,237	(8,989)
CLAY 345.00-CLAY 115.00	C	C	280	(280)	3,317	(3,317)
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(1,891)	36,663	(6,769)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,859)	18,288	(16,974)
VOLNEY SCRIBA	C	C	45,074	(31,519)	63,524	(42,942)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(35,016)	50,103	(47,637)
CENTRAL EAST	D/E/F	NE/F	304,699	(54,092)	283,680	(43,435)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**(120,066)**	**1,953,340**	**(137,668)**

Impacts on Zonal LBMPs ($/MWh)

Area	2019 Base	2019 Impact	2024 Base	2024 Impact
WEST (A)	37.43	1.23	51.71	1.06
GENESSEE (B)	35.23	1.39	47.04	1.72
CENTRAL (C)	36.19	1.31	48.28	1.43
NORTH (D)	33.78	1.75	45.70	1.92
MOHAWKVA (E)	35.82	1.57	47.82	1.79
CAPITAL (F)	46.52	(1.50)	57.79	(0.92)
HUDSONVA (G)	44.23	(0.65)	56.54	(0.61)
MILLWOOD (H)	44.52	(0.61)	56.89	(0.60)
DUNWOODI (I)	44.47	(0.59)	56.92	(0.61)
NYCITY (J)	45.02	(0.48)	57.44	(0.51)
LONGISLA (K)	48.69	(0.28)	61.86	(0.06)

Impacts on Production Costs ($m)

	2019 Base	2019 Impact	2024 Base	2024 Impact
NYCA+Imports-Exports	3,511	(39)	4,277	(24)
Total System	29,736	(35)	41,023	(23)

Source: The Brattle Group analysis using MAPS

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

P12 NYTO

Input Changes:

- Topology: new line from Edic to New Scotland; reconductor NS-Leeds-PV
- Leeds-PV limit on existing line : pre-2024 limit increased by 523 MW with Leeds-PV reconductor
- Rating increases on other lines binding in Base Case:
  - 2019 & 2024: New Scotland Leeds increases 616 MW, CPV_VLY 345.00-ROCK TAV 345.00 increases 352 MW.
- Central East limits: increase by 375 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
DUNWOODIE SHORE ROAD	I	K	27,558	2,587	31,945	4,061
MOTTHAVEN RAINEY	J	J	1,456	1,522	345	726
HUNTLEY PACKARD	A	A	47,704	678	74,237	(10,139)
Ramapo PAR	G	G	15,149	294	6,459	3,672
CLAY 345.00-CLAY 115.00	C	C	280	(280)	3,317	(3,307)
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(2,582)	36,663	(8,784)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,859)	18,288	(18,288)
VOLNEY SCRIBA	C	C	45,074	(30,064)	63,524	(41,231)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(31,499)	50,103	(39,627)
CENTRAL EAST	D/E/F	NE/F	304,699	(63,281)	283,680	(49,165)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**(141,831)**	**1,953,340**	**(145,200)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	**Base**	**Impact**	**Base**	**Impact**
WEST (A)	37.43	1.40	51.71	1.15
GENESSEE (B)	35.23	1.60	47.04	1.95
CENTRAL (C)	36.19	1.50	48.28	1.62
NORTH (D)	33.78	1.97	45.70	2.14
MOHAWKVA (E)	35.82	1.74	47.82	1.95
CAPITAL (F)	46.52	(1.66)	57.79	(1.02)
HUDSONVA (G)	44.23	(0.67)	56.54	(0.50)
MILLWOOD (H)	44.52	(0.64)	56.89	(0.50)
DUNWOODI (I)	44.47	(0.64)	56.92	(0.54)
NYCITY (J)	45.02	(0.53)	57.44	(0.45)
LONGISLA (K)	48.69	(0.24)	61.86	0.04

Impacts on Production Costs ($m)

	2019		2024	
	Base	**Impact**	**Base**	**Impact**
NYCA+Imports-Exports	3,511	(30)	4,277	(39)
Total System	29,736	(32)	41,023	(25)

Source: The Brattle Group analysis using MAPS

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

P14 NYTO

Input Changes:

- Topology: new line from Edic to New Scotland; reconductor NS-Leeds-PV
- Leeds-PV limit on existing line : pre-2024 limit tightened by 93 MW
- Rating increases on other lines binding in Base Case:
  - 2019 & 2024: New Scotland Leeds increases 616 MW, CPV_VLY 345.00-ROCK TAV 345.00 increases 352 MW
- Central East limits: increase by 375MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
DUNWOODIE SHORE ROAD	I	K	27,558	2,726	31,945	4,008
MOTTHAVEN RAINEY	J	J	1,456	1,745	345	687
Ramapo PAR	G	G	15,149	743	6,459	3,628
HUNTLEY PACKARD	A	A	47,704	201	74,237	(9,770)
CLAY 345.00-CLAY 115.00	C	C	280	(280)	3,317	(3,317)
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(2,418)	36,663	(8,649)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,859)	18,288	(18,288)
VOLNEY SCRIBA	C	C	45,074	(30,051)	63,524	(41,554)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(32,970)	50,103	(42,368)
CENTRAL EAST	D/E/F	NE/F	304,699	(58,230)	283,680	(45,082)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**(132,738)**	**1,953,340**	**(139,574)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.43	1.35	51.71	1.14
GENESSEE (B)	35.23	1.56	47.04	1.92
CENTRAL (C)	36.19	1.47	48.28	1.62
NORTH (D)	33.78	1.92	45.70	2.12
MOHAWKVA (E)	35.82	1.72	47.82	1.96
CAPITAL (F)	46.52	(1.49)	57.79	(0.84)
HUDSONVA (G)	44.23	(0.70)	56.54	(0.57)
MILLWOOD (H)	44.52	(0.68)	56.89	(0.58)
DUNWOODI (I)	44.47	(0.66)	56.92	(0.60)
NYCITY (J)	45.02	(0.55)	57.44	(0.50)
LONGISLA (K)	48.69	(0.24)	61.86	(0.01)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,511	(30)	4,277	(39)
Total System	29,736	(34)	41,023	(24)

Source: The Brattle Group analysis using MAPS

P19a NextEra

Input Changes:

- Topology: add new lines from Knickerbocker to Pleasant Valley
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW with early SPS retirement
- Ratings increases on other lines binding in Base Case:
  - 2019 & 2024: CPV_VLY 345.00-ROCK TAV 345.00 increases 352 MW
- Central East limits: increase by 50 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
CENTRAL EAST	D/E/F	NE/F	304,699	11,839	283,680	13,803
HUNTLEY PACKARD	A	A	47,704	2,317	74,237	(6,391)
KNICKERBOCK 345.00-N.SCOT77 345.00	F	F	N/A	2,148	N/A	2,790
DUNWOODIE SHORE ROAD	I	K	27,558	687	31,945	2,728
Ramapo PAR	G	G	15,149	154	6,459	2,485
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(22)	36,663	(2,647)
CLAY 345.00-CLAY 115.00	C	C	280	(158)	3,317	(2,909)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,815)	18,288	(17,536)
VOLNEY SCRIBA	C	C	45,074	(18,742)	63,524	(34,038)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(34,375)	50,103	(44,283)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**(19,126)**	**1,953,340**	**(70,509)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	**Base**	**Impact**	**Base**	**Impact**
WEST (A)	37.43	0.32	51.71	0.26
GENESSEE (B)	35.23	0.23	47.04	0.58
CENTRAL (C)	36.19	0.21	48.28	0.36
NORTH (D)	33.78	0.22	45.70	0.49
MOHAWKVA (E)	35.82	0.28	47.82	0.54
CAPITAL (F)	46.52	0.19	57.79	0.54
HUDSONVA (G)	44.23	(0.26)	56.54	(0.39)
MILLWOOD (H)	44.52	(0.21)	56.89	(0.39)
DUNWOODI (I)	44.47	(0.22)	56.92	(0.43)
NYCITY (J)	45.02	(0.15)	57.44	(0.35)
LONGISLA (K)	48.69	(0.10)	61.86	(0.03)

Impacts on Production Costs ($m)

	2019		2024	
	Base	**Impact**	**Base**	**Impact**
NYCA+Imports-Exports	3,511	(8)	4,277	(17)
Total System	29,736	(10)	41,023	(11)

Source: The Brattle Group analysis using MAPS

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

P20 Boundless

Input Changes:

- Topology: NS-LD SR, (LD-PV, LD-HA, CPV-RT reconductor), LD-HA-R SC, RS-EF two cables
- Leeds-PV limit on existing line: pre-2024 limit increased by 551 MW with Leeds-PV reconductor
- Ratings increases on other lines binding in Base Case:
  - 2019 & 2024: CPV_VLY 345.00-ROCK TAV 345.00 increases 1050MW
- Central East limits: *decrease* by 25 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
HURLEYSC 345.00-ROSETON 345.00	G	G	N/A	15,456	N/A	29,693
CENTRAL EAST	D/E/F	NE/F	304,699	13,941	283,680	12,703
HUNTLEY PACKARD	A	A	47,704	1,587	74,237	(3,963)
DUNWOODIE SHORE ROAD	I	K	27,558	509	31,945	2,043
Ramapo PAR	G	G	15,149	340	6,459	3,256
CLAY 345.00-CLAY 115.00	C	C	280	(168)	3,317	(2,627)
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(372)	36,663	(1,664)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,859)	18,288	(18,288)
VOLNEY SCRIBA	C	C	45,074	(10,917)	63,524	(16,668)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(35,636)	50,103	(50,103)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**4,910**	**1,953,340**	**(15,711)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	**Base**	**Impact**	**Base**	**Impact**
WEST (A)	37.43	0.18	51.71	0.21
GENESSEE (B)	35.23	0.13	47.04	0.39
CENTRAL (C)	36.19	0.12	48.28	0.24
NORTH (D)	33.78	0.07	45.70	0.27
MOHAWKVA (E)	35.82	0.16	47.82	0.36
CAPITAL (F)	46.52	0.44	57.79	0.51
HUDSONVA (G)	44.23	(0.13)	56.54	(0.28)
MILLWOOD (H)	44.52	(0.08)	56.89	(0.20)
DUNWOODI (I)	44.47	(0.09)	56.92	(0.24)
NYCITY (J)	45.02	(0.05)	57.44	(0.21)
LONGISLA (K)	48.69	(0.00)	61.86	0.06

Impacts on Production Costs ($m)

	2019		2024	
	Base	**Impact**	**Base**	**Impact**
NYCA+Imports-Exports	3,511	(3)	4,277	(10)
Total System	29,736	(9)	41,023	(12)

Source: The Brattle Group analysis using MAPS

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

P21 Boundless

Input Changes:

- Topology: NS-LD SR, (LD-HA, CPV-RT reconductor), LD-HA-R SC, RS-EF two cables
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW
- Ratings increases on other lines binding in Base Case :
  - 2019 & 2024: CPV_VLY 345.00-ROCK TAV 345.00 increases 1050MW
- Central East limits: *decrease* by 25 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO, in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
HURLEYSC 345.00-ROSETON 345.00	G	G	N/A	17,543	N/A	32,512
CENTRAL EAST	D/E/F	NE/F	304,699	10,301	283,680	10,613
HUNTLEY PACKARD	A	A	47,704	1,651	74,237	(4,794)
Ramapo PAR	G	G	15,149	458	6,459	3,130
DUNWOODIE SHORE ROAD	I	K	27,558	376	31,945	1,738
CLAY 345.00-CLAY 115.00	C	C	280	(169)	3,317	(2,592)
GARDV230 230.00-STOLE230 230.00	A	A	7,130	(514)	36,663	(1,645)
LEEDS PLEASANT VALLEY	F	G	4,859	(4,859)	18,288	(18,288)
VOLNEY SCRIBA	C	C	45,074	(10,227)	63,524	(15,683)
CPV_VLY 345.00-ROCK TAV 345.00	G	G	35,636	(35,636)	50,103	(50,103)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,381,332**	**3,572**	**1,953,340**	**2,330**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	**Base**	**Impact**	**Base**	**Impact**
WEST (A)	37.43	0.20	51.71	0.19
GENESSEE (B)	35.23	0.15	47.04	0.40
CENTRAL (C)	36.19	0.15	48.28	0.24
NORTH (D)	33.78	0.10	45.70	0.27
MOHAWKVA (E)	35.82	0.18	47.82	0.36
CAPITAL (F)	46.52	0.35	57.79	0.45
HUDSONVA (G)	44.23	(0.15)	56.54	(0.28)
MILLWOOD (H)	44.52	(0.08)	56.89	(0.19)
DUNWOODI (I)	44.47	(0.09)	56.92	(0.22)
NYCITY (J)	45.02	(0.06)	57.44	(0.19)
LONGISLA (K)	48.69	(0.03)	61.86	0.03

Impacts on Production Costs ($m)

	2019		2024	
	Base	**Impact**	**Base**	**Impact**
NYCA+Imports-Exports	3,511	(3)	4,277	(9)
Total System	29,736	(6)	41,023	(9)

Source: The Brattle Group analysis using MAPS

P20 and P21 Boundless and Central East

Impact on Central East Limits

- Production Costs savings are smaller with P20 and P21 because the Central East limit *decreases* (by 25 MW) with these portfolios, compared to others where they increase
  - Benefits of UPNY-SENY limit increase is not as utilized as other cases; lower downstate LBMP and higher upstate LBMP, but price impacts are generally smaller

P20 Impacts on LBMPs

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.43	0.18	51.71	0.21
GENESSEE (B)	35.23	0.13	47.04	0.39
CENTRAL (C)	36.19	0.12	48.28	0.24
NORTH (D)	33.78	0.07	45.70	0.27
MOHAWKVA (E)	35.82	0.16	47.82	0.36
CAPITAL (F)	46.52	0.44	57.79	0.51
HUDSONVA (G)	44.23	(0.13)	56.54	(0.28)
MILLWOOD (H)	44.52	(0.08)	56.89	(0.20)
DUNWOODI (I)	44.47	(0.09)	56.92	(0.24)
NYCITY (J)	45.02	(0.05)	57.44	(0.21)
LONGISLA (K)	48.69	(0.00)	61.86	0.06

P21 Impacts on LBMPs

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.43	0.20	51.71	0.19
GENESSEE (B)	35.23	0.15	47.04	0.40
CENTRAL (C)	36.19	0.15	48.28	0.24
NORTH (D)	33.78	0.10	45.70	0.27
MOHAWKVA (E)	35.82	0.18	47.82	0.36
CAPITAL (F)	46.52	0.35	57.79	0.45
HUDSONVA (G)	44.23	(0.15)	56.54	(0.28)
MILLWOOD (H)	44.52	(0.08)	56.89	(0.19)
DUNWOODI (I)	44.47	(0.09)	56.92	(0.22)
NYCITY (J)	45.02	(0.06)	57.44	(0.19)
LONGISLA (K)	48.69	(0.03)	61.86	0.03

P20 Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,511	(3)	4,277	(10)
Total System	29,736	(9)	41,023	(12)

P21 Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,511	(3)	4,277	(9)
Total System	29,736	(6)	41,023	(9)

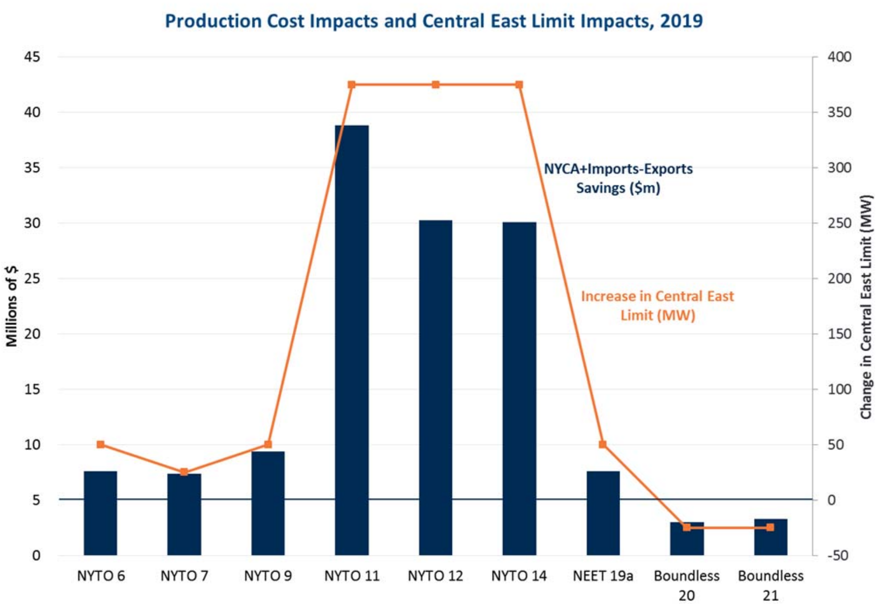
Source: The Brattle Group analysis using MAPS

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

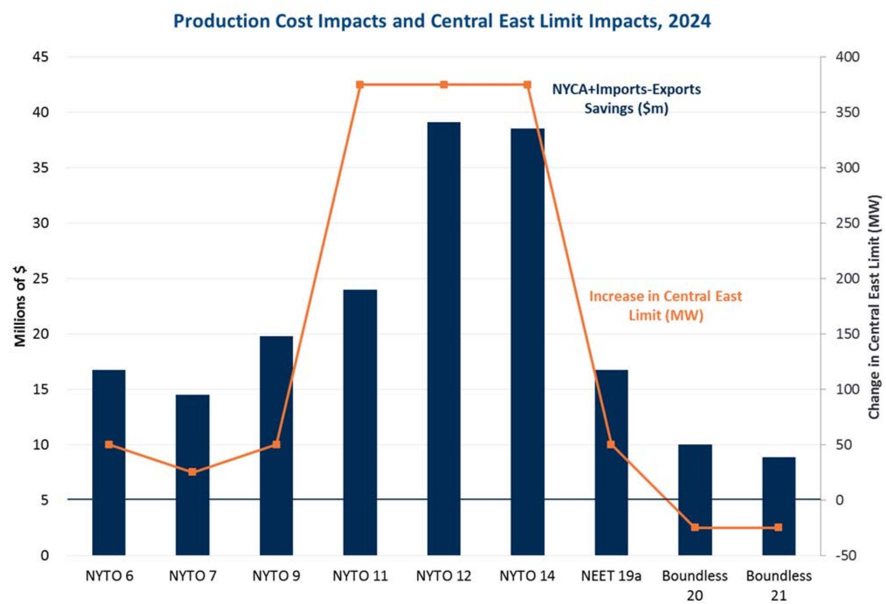
Production Cost and C/E Limit Changes

Production cost savings are correlated to changes in Central East Interface limit

- Significant increases to the Central East limit can improve the PCS associated with UPNY/SENY upgrades
- Once UPNY/SENY is upgraded (and no longer constrained), higher Central East limit enables more flow from upstate to downstate



Source: GE MAPS output files.

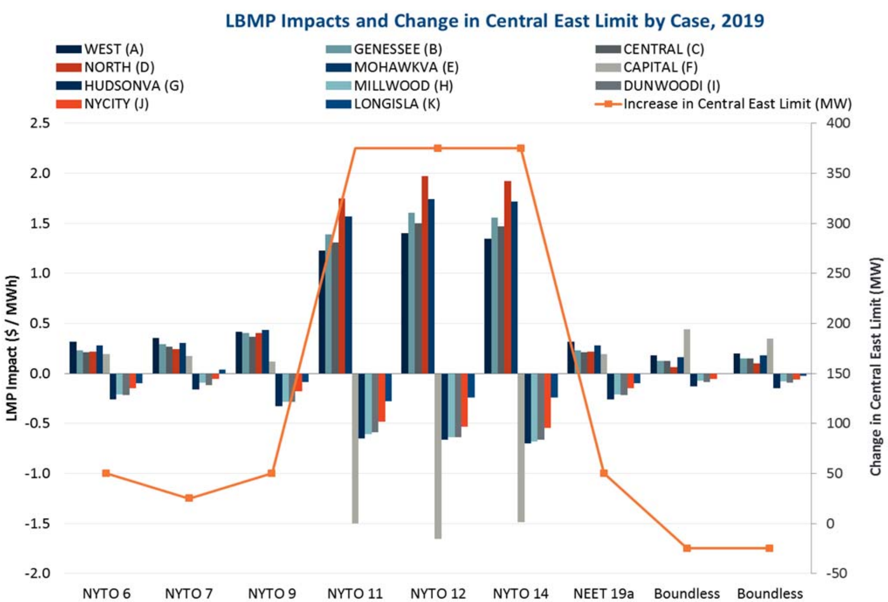


Source: GE MAPS output files.

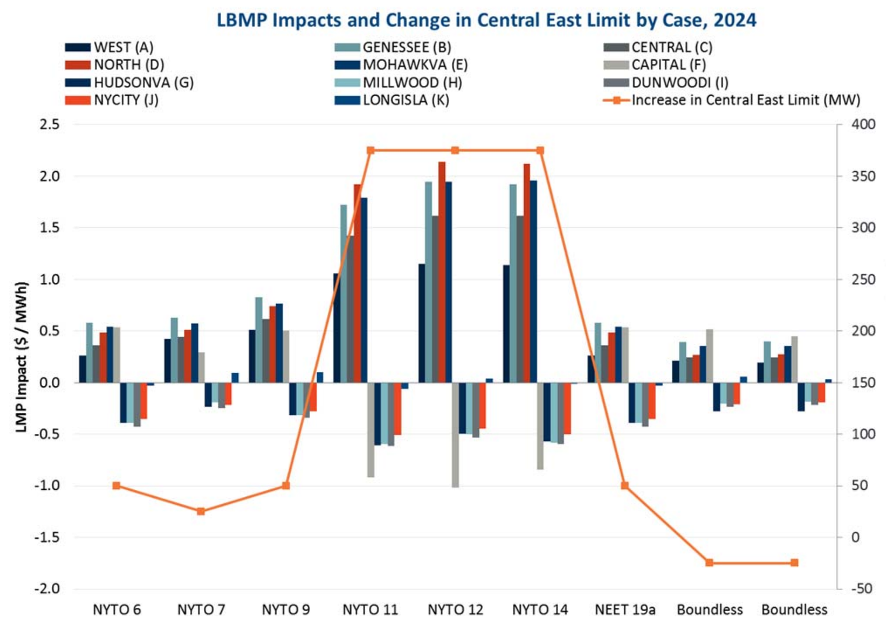
LBMP Impacts and C/E Limit Changes

Central East limits impact zonal LBMP patterns

- Higher Central East limits for P11, P12, and P14 lowers LBMP for Zone F, while other portfolios with smaller increase in Central East limits show higher LBMPs for Zone F
- This indicates that P11, P12, and P14 may have additional production cost savings benefits from increasing UPNY/SENY transfer limits further (i.e., UPNY/SENY is the limiting factor for these portfolios while Central East is limiting for other portfolios)



Source: GE MAPS output files.

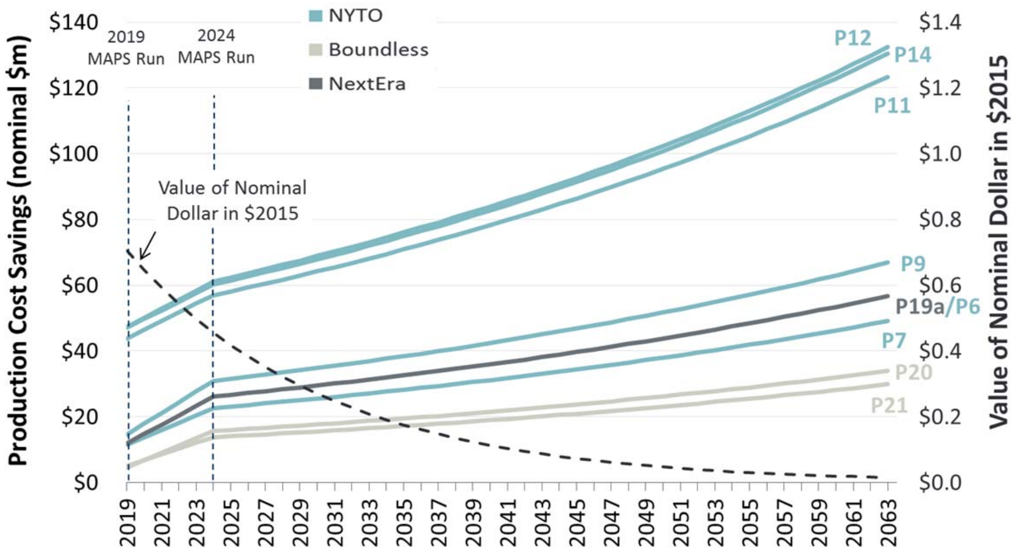


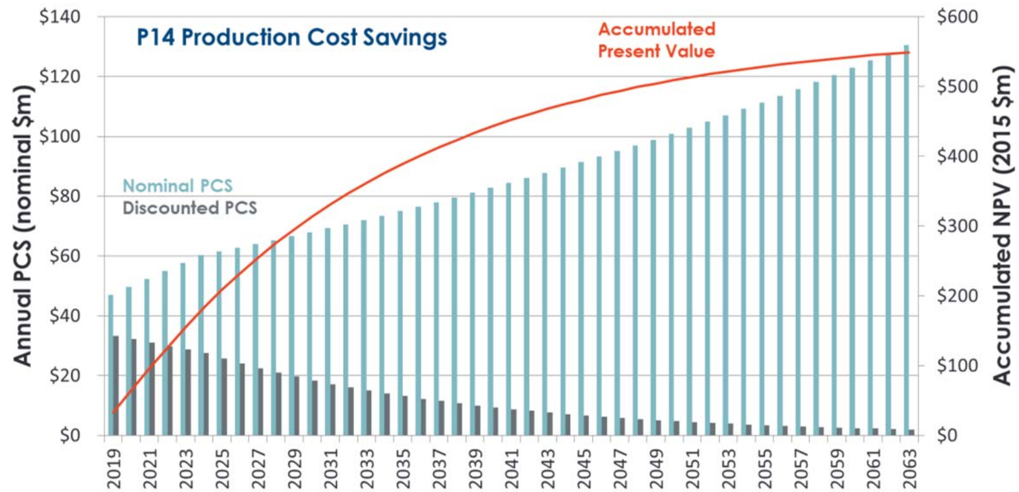
Source: GE MAPS output files.

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

Production Cost Savings from MAPS

- Production cost savings from MAPS for 2019 and 2024 used to estimate savings over physical life of assets
  - 2020 – 2023: Interpolate linearly between 2019 and 2024 results in nominal terms
  - 2024 – 2063: Escalate 2024 results by 2% per year to remain constant in real terms
  - *Note*: REV resources not shown here due to significantly higher annual production cost savings of $208m in 2019 and $331m in 2024
- Calculate NPV of production cost savings by discounting future savings back to 2015 dollars using 9.13% discount rate recommended by DPS
- NPV of production cost savings for P14 shown here for demonstration purposes





Production Cost Savings for REV Resources

REV alternative reduces the NPV of production costs by ~$1.9 billion

- PCS are calculated in 2019 and 2024 using zonal average LBMPs from MAPS
- REV resources are assumed to be phased in from 2016-2020 (20% of total each year); GWh savings shown below apply to years in which full 1,200 MW peak reduction is achieved
- Savings are likely optimistic due to assumption that avoided production costs are equal to LBMP *times* Energy Savings and the high assumed capacity factor of EE (offset somewhat by assuming average LBMPs, instead of load-weighted LBMPs)

Estimated Production Cost Savings of the REV Alternative

	Annual GWh Energy Savings by Zone					Nominal 2019 Savings ($m)	Nominal 2024 Savings ($m)	Measure Life	NPV
Resource Type	G	H	I	J	Total	G-J	G-J	(years)	**(2015 $m)**
Energy Efficiency	598	154	328	4,417	**5,497**	$197	$315	12	$1,809
Customer-sited Renewables	31	8	7	53	**98**	$4	$6	25	$48
Combined Heat & Power	4	0	0	190	**195**	$7	$11	20	$88
Demand Response	0	0	0	0	**0**	$0	$0	10	$0
Fossil Fuel Distributed Generation	0	0	0	0	**0**	$0	$0	--	$0
Grid Integrated Vehicles	(0)	(0)	(0)	(1)	**(2)**	($0.1)	($0.1)	10	($0)
Storage (flywheel and battery)	(1)	(0)	(0)	(3)	**(5)**	($0.2)	($0.3)	15	($2)
Rate Structures	0	0	0	0	**0**	$0	$0	15	
Total	**632**	**161**	**335**	**4,656**	**5,783**	**$208**	**$331**		**$1,943**

Sources: REV GEIS. See slide 51 for sources supporting resource distribution and economic life estimates.

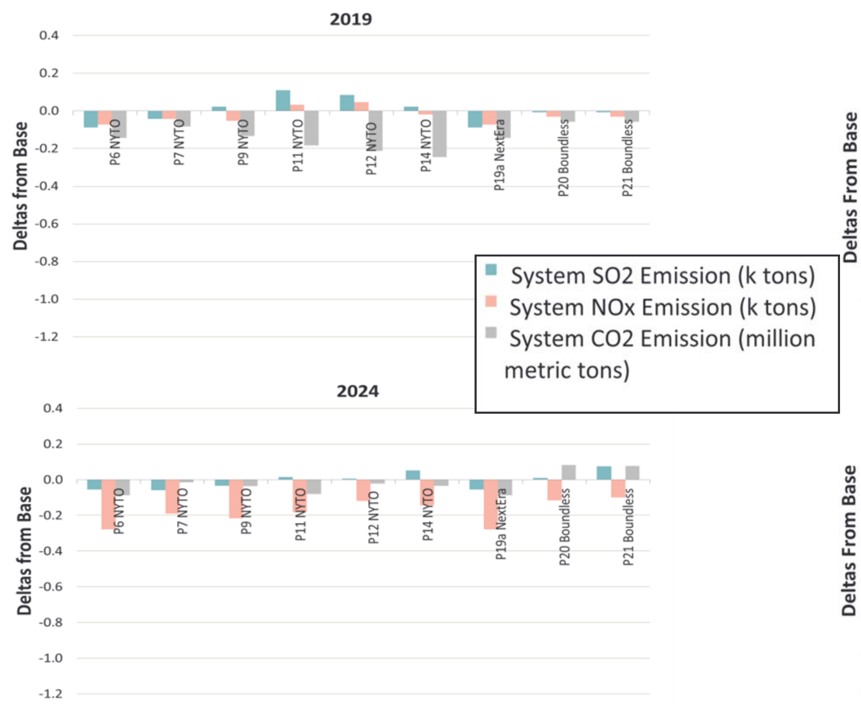
* REV case was not modeled in MAPS, although PCS are calculated using LBMPs from MAPS

Emissions Impacts from MAPS

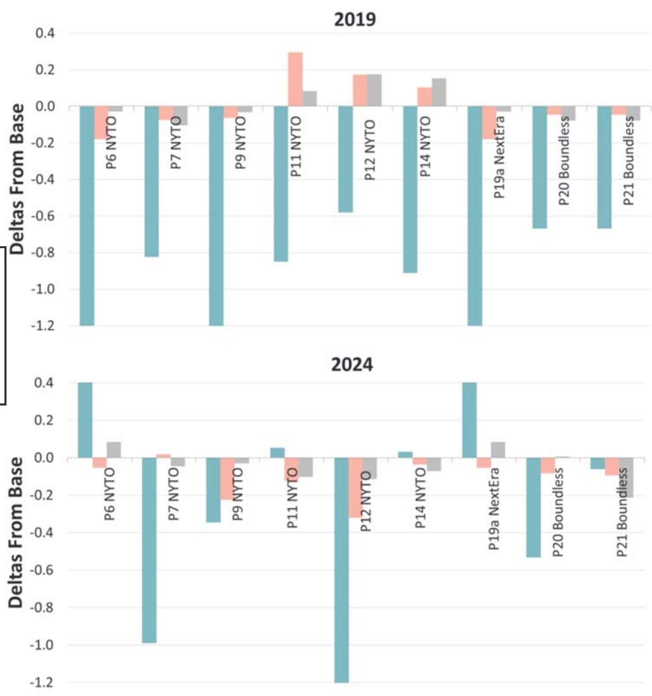
No clear patterns among various portfolios

- Emission allowance prices have small impact on the marginal cost of generation
- CO_2 emission reduction for NYCA across all Change Cases indicates a more efficient dispatch (less fossil fuel usage) with transmission upgrades
- Change in coal unit dispatch (Huntley and Somerset) largely explains the NYCA-wide emissions changes, as described in the following slides

NYCA-wide Change in Emissions



System-wide Change in Emissions

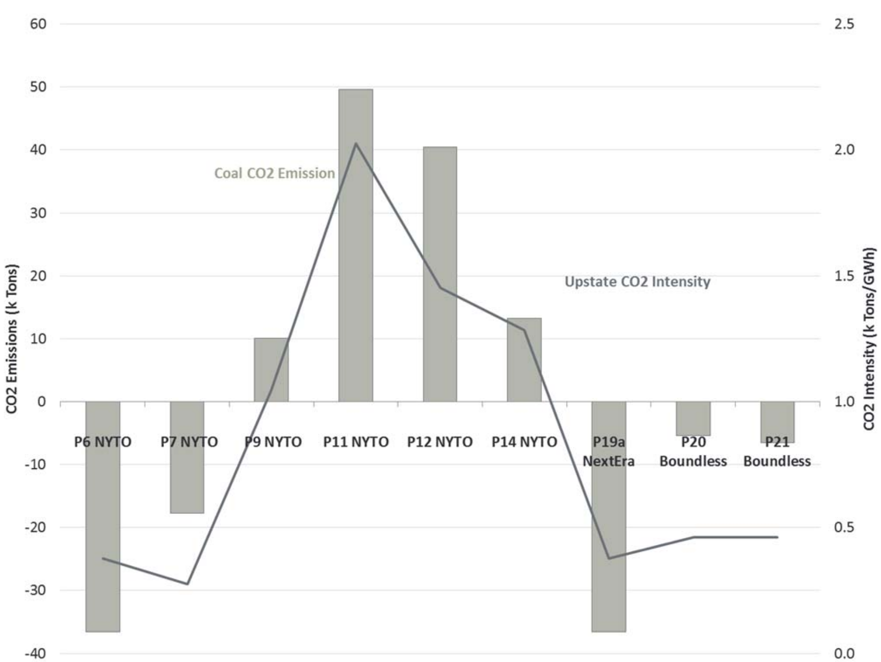


CO_2 Emissions Impacts

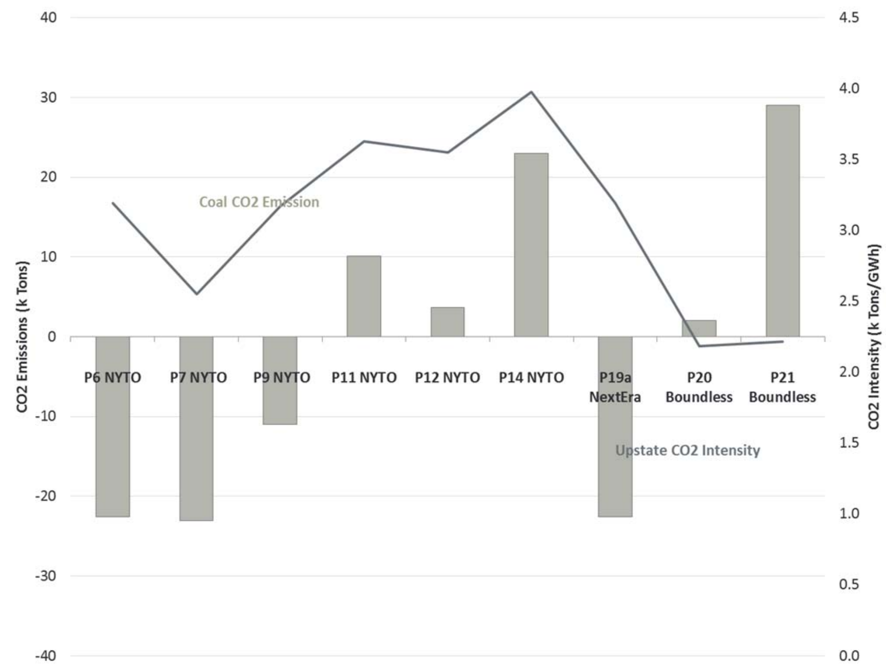
Trends in emissions can be explained largely by changes in generation from coal plants

- Upstate CO_2 intensity (shown as line in figures below) mostly follows changes in emissions from two upstate coal plants - Huntley and AES Somerset (shown as bars in figures below)
- Downstate CO_2 intensity is less than the Base Case in all Change Cases (not shown here)

2019 Coal CO_2 Emissions and Upstate CO_2 Intensity (Deltas from Base Case)



2024 Coal CO_2 Emissions and Upstate CO_2 Intensity (Deltas from Base Case)



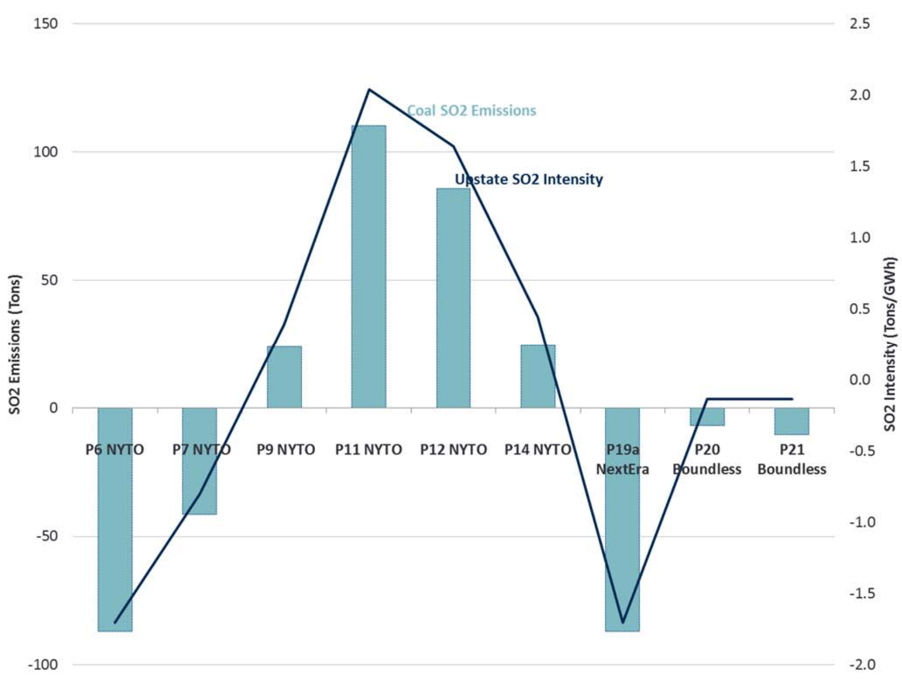
V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

SO_2 Emissions Impacts

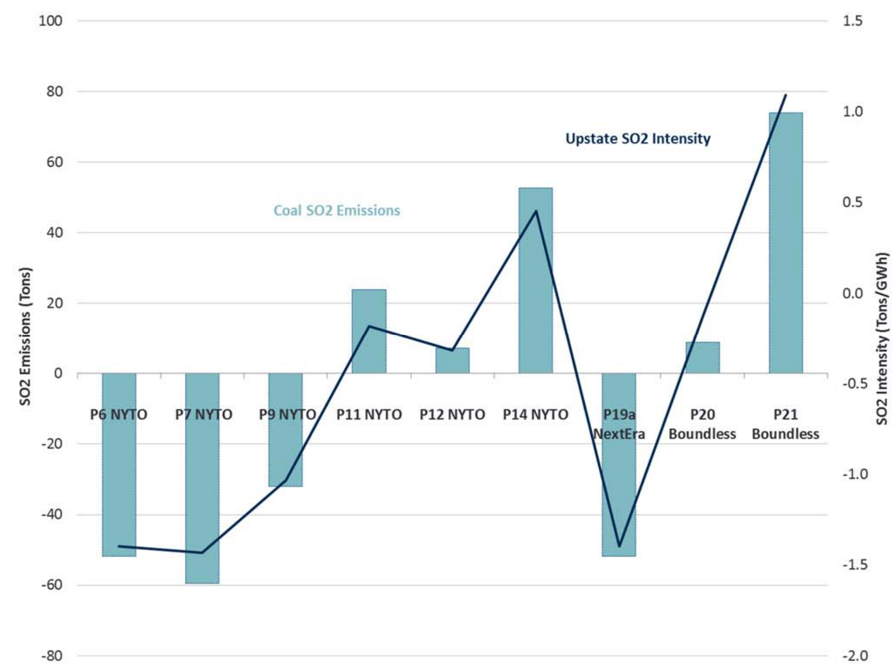
Trends in emissions can largely be explained by changes in generation from coal plants

- Upstate SO_2 intensity (shown as line in figures below) mostly follows changes in emissions from two upstate coal plants - Huntley and AES Somerset (shown as bars in figures below)
- Downstate SO_2 intensity is generally the same as the Base Case (not shown here)

2019 Coal SO_2 Emissions and Upstate SO_2 Intensity (Deltas from Base Case)



2024 Coal SO_2 Emissions and Upstate SO_2 Intensity (Deltas from Base Case)

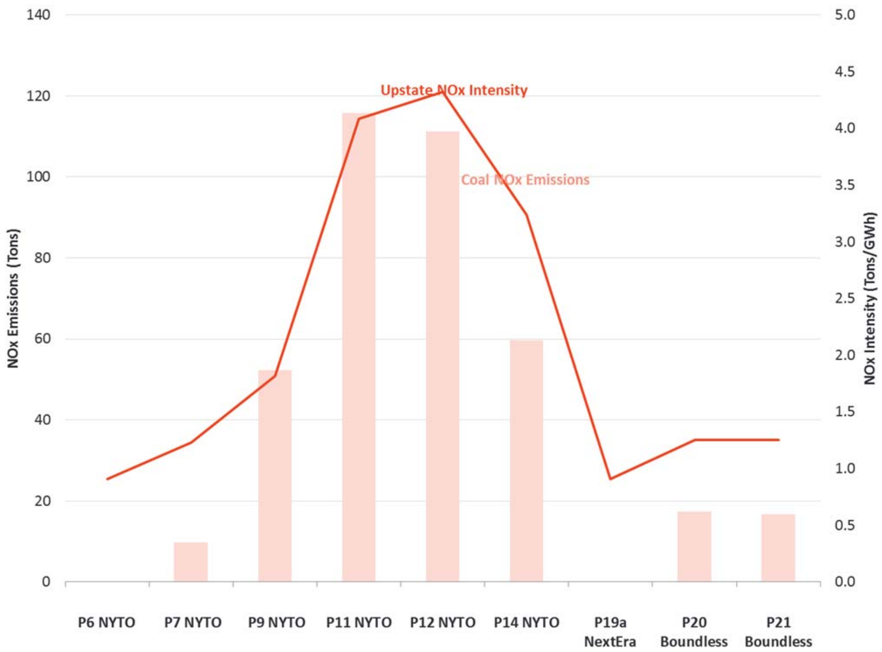


NOx Emissions Impacts

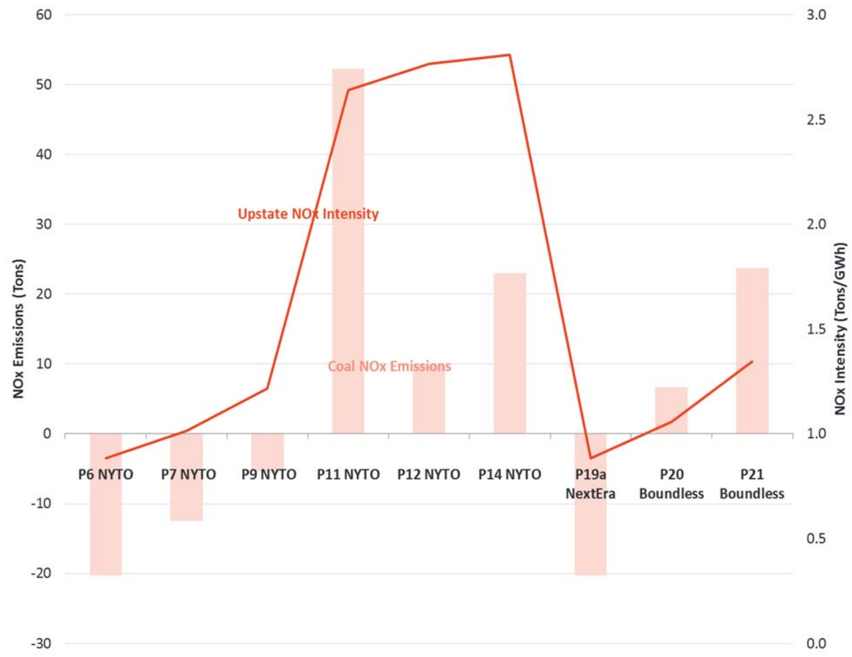
Trends in emissions can be explained largely by changes in generation from coal plants

- Upstate NOx intensity (shown as line in figures below) mostly follows changes in emissions from two upstate coal plants - Huntley and AES Somerset (shown as bars in figures below)
- Downstate NOx intensity is less than the Base Case in all Change Cases (not shown here)

2019 Coal NOx Emissions and Upstate NOx Intensity (Deltas from Base Case)



2024 Coal NOx Emissions and Upstate NOx Intensity (Deltas from Base Case)



Note: Delta to Base NOx emissions in P6 and P19a virtually zero out when summing over Huntley (-98 compared to base) and Somerset (+98 compared to Base)

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

Summary of CARIS Metrics

		Base Case		NYTO 6		NYTO 7		NYTO 9		NYTO 11		NYTO 12		NYTO 14		NEET 19a		Boundless 20		Boundless 21		REV	
		2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024
	units	*Absolute*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*	
Production Costs (PC)																							
NYCA Adjusted PC	*$m*	3,511	4,277	-8	-17	-7	-15	-9	-20	-39	-24	-30	-39	-30	-39	-8	-17	-3	-10	-3	-9		
Total System PC	*$m*	29,736	41,023	-10	-11	-5	-11	-18	-18	-35	-23	-32	-25	-34	-24	-10	-11	-9	-12	-6	-9		
Payments																							
NYCA Generator	*$m*	5,475	7,491	35	70	33	73	30	87	72	130	77	149	77	148	35	70	19	57	20	53		
NYCA Load Payments	*$m*	6,835	8,915	2	-2	9	7	6	18	19	27	17	35	21	39	2	-2	8	3	5	0		
Congestion Rents																							
NYCA Congestion	*$m*	844	1,080	-39	-85	-33	-72	-44	-78	-111	-143	-125	-152	-120	-152	-39	-85	-22	-48	-23	-47		
Emissions																							
NYCA CO2	*1000 tons*	28,274	31,208	-144	-87	-84	-15	-134	-36	-184	-79	-213	-22	-246	-34	-144	-87	-58	83	-42	78	-1,231	-1,538
	%			-0.5%	-0.3%	-0.3%	0.0%	-0.5%	-0.1%	-0.7%	-0.3%	-0.8%	-0.1%	-0.9%	-0.1%	-0.5%	-0.3%	-0.2%	0.3%	-0.1%	0.2%		
NYCA SOX	*tons*	2,754	3,379	-88	-54	-43	-58	23	-34	109	14	85	6	23	51	-88	-54	-7	9	-11	74	-1,725	-2,157
	%			-3.2%	-1.6%	-1.5%	-1.7%	0.8%	-1.0%	4.0%	0.4%	3.1%	0.2%	0.8%	1.5%	-3.2%	-1.6%	-0.3%	0.3%	-0.4%	2.2%		
NYCA NOX	*tons*	17,207	18,665	-73	-278	-43	-189	-53	-217	32	-183	45	-119	-19	-144	-73	-278	-32	-115	-22	-100	-1,438	-1,797
	%			-0.4%	-1.5%	-0.3%	-1.0%	-0.3%	-1.2%	0.2%	-1.0%	0.3%	-0.6%	-0.1%	-0.8%	-0.4%	-1.5%	-0.2%	-0.6%	-0.1%	-0.5%		
Total System CO2	*1000 tons*	482,635	445,620	-29	84	-104	-46	-32	-29	84	-102	175	-115	153	-71	-29	84	-78	6	-33	-213		
	%			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
Total System SOX	*tons*	316,731	288,491	-1,589	657	-824	-990	-1,366	-345	-849	53	-580	-1,293	-912	31	-1,589	657	-669	-532	-771	-61		
	%			-0.5%	0.2%	-0.3%	-0.3%	-0.4%	-0.1%	-0.3%	0.0%	-0.2%	-0.4%	-0.3%	0.0%	-0.5%	0.2%	-0.2%	-0.2%	-0.2%	0.0%		
Total System NOX	*tons*	329,019	307,225	-180	-54	-74	17	-64	-225	296	-123	173	-321	103	-35	-180	-54	-46	-83	-50	-94		
	%			-0.1%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.1%	0.0%	0.1%	-0.1%	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%		

Notes:

Red values indicate adverse impacts (such as increasing costs or greater emissions)

NYCA Adjusted Production Cost Savings is defined as Total NYCA+Imports-Exports, with Imports and Exports valued at border LBMPs

ICAP Savings not shown here; see next section of this presentation

REV metrics calculated using MAPS base case LBMPs; emissions from EIS report

IP Retirement: Assumptions

What would be the production cost savings of new transmission if Indian Point retired in 2019 without forewarning? Compare two scenarios:

- **IP-Out Base Case with Compensating Generation**
  - No need for any compensating generation through 2021.
  - 330 MW CC online by 2022 (330 MW is consistent with CARIS assumptions) to meet reliability standards (7,000 Btu/kWh full load heat rate and $7/MWh VOM, distributed among high voltage buses in Zone G)

Adjusted Compensatory MW (Zones G-J)

	Compensating MW Needed with Indian Point Retirement						
	2016	2019	2020	2021	2022	2023	2024
	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)
2014 CRP Compensatory MW	500						
2014 Gold Book G-J Non-Coincident Summer Peak Load	16,749						
2015 Gold Book G-J Non-Coincident Summer Peak Load	16,441	16,800	16,867	16,957	17,053	17,158	17,263
Change in Load (relative to 2016 in 2014 Gold Book)	-308	51	118	208	304	409	514
Compensatory MW Needs (without CPV Valley)	192	551	618	708	804	909	1,014
Compensating MW Needs with CPV Valley (760 MW)	-568	-209	-142	-52	44	149	254

Sources: 2014 CRP (p. 23); 2014 Gold Book (p. 14); 2015 Long Term Forecast from NYISO .

- **IP-Out with Tx Solution** (modeling in MAPS one representative Tx portfolio)
  - Tx in service prior to IP surprise retirement
  - No compensating generation needed for reliability since Tx provides adequate imports to SENY

While these scenarios relate to the retirement of Indian Point, similar (though less extreme) conclusions could be drawn about other large potential retirements

V.A.2. MAPS Analysis of Production Cost Savings: Change Cases

IP Retirement: Production Cost and LBMP Impacts

- NYCA-wide production cost savings from the **IP-Out with Tx Solution** scenario as compared to the **IP-Out Base Case with Compensating Generation** scenario are $749m in NPV terms
- 21% of the PV of production cost savings occur in the 3 years w/o compensating generation
  - The addition of CPV limits the benefits of the Tx solution as compared to the compensating generation solution, as less generation is needed to meet reliability with the retirement of Indian Point (only 330 MW needs to be added in 2022 to meet reliability).

Production Costs Savings from Transmission

Production Cost Savings	NPV ($m)	Percent of Total
No Compenating Generation (2019 - 2021)	160	21%
With Compenating Generation (2022 - 2063)	590	79%
Total (2019 - 2063)	749	100%

- Zone G LBMP impact of the **IP-Out with Tx Solution** (compared to the IP-Out Base Case with Compensating Generation starting in 2022) is **-$0.88** in in 2019 but **+$0.00** in 2024
- LBMP Impact changes more significantly in Zone G from 2019 to 2024 than in surrounding areas.

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	IP-Out Base Case with Compensating Generation	Impact of Tx with IP Out (and no compensating Gen)	IP-Out Base Case with Compensating Generation	Impact of Tx with IP Out (and no compensating Gen)
WEST (A)	38.23	1.67	51.44	2.11
GENESSEE (B)	36.08	1.91	47.37	2.66
CENTRAL (C)	37.14	1.82	48.65	2.43
NORTH (D)	34.59	2.20	45.96	2.86
MOHAWKVA (E)	36.72	2.14	48.14	2.85
CAPITAL (F)	48.68	(0.88)	59.13	0.00
HUDSONVA (G)	47.39	(0.96)	59.54	(0.88)
MILLWOOD (H)	47.65	(0.87)	60.02	(0.95)
DUNWOODI (I)	47.71	(0.96)	60.20	(1.11)
NYCITY (J)	47.92	(0.85)	60.46	(1.00)
LONGISLA (K)	50.01	(0.37)	63.32	(0.42)

Contents

V.B. Additional Production Cost Savings

Additional Production Cost Related Benefits

MAPS represents operation of the power system under ideal, normalized conditions that is useful for analyzing impacts of changes to the system, but provides an incomplete picture of the operation of the real-world power system

- MAPS assumes no transmission outages, and no *uncertainty* in load forecasts, wind/solar output, or generation outages
- Normalized future conditions will not capture full range of circumstances (e.g., hot summers, gas shortages, major retirements) that are likely to stress the system in future years
- 2013 CARIS report highlights this issue, noting that congestion modeled in MAPS tends to be significantly lower than the historical system congestion

These factors could be included in MAPS by running many scenarios but there was insufficient time to do so during this study

We therefore relied on multipliers to the MAPS-generated production cost savings (PCS) to capture the additional value provided by Tx, Gen, and REV in the real-world power system

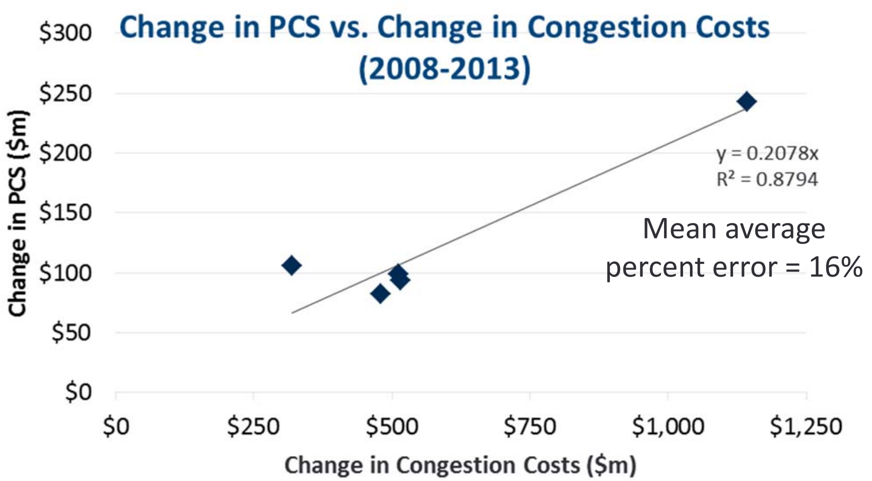
- For Tx portfolios, we apply 1.56 multiplier based on a comparison of zonal LBMP differentials in MAPS to zonal LBMP differentials in recent electricity futures contracts (Zone A vs. G)
- For Generation, we apply 1.24 multiplier based on the ratio of market heat rate spreads (MHR – CC HR of 7,000 Btu/kWh) between modeled results and futures (for Zone G)
- For REV resources, we apply 1.03 (Zones GHI) or 1.06 (Zone J) multiplier based on difference in zonal LBMPs between modeled results and futures and resource location

Our approach for developing these PCS multipliers is discussed in the following slides

Approach for Developing PCS Multipliers for Tx

Adding transmission capacity lowers production costs by relieving congestion, which MAPS understates

We estimate that production costs vary linearly with congestion costs based on CARIS analysis of 2008-2013, where NYISO re-ran market software with Tx constraints removed; showed that production cost savings was a nearly constant multiple of congestion costs, i.e., a change in congestion costs produces the same % change in production cost savings



Source: CARIS 2013, Table 5-3. Note that TCC payments represent congestion costs.

Therefore, we can estimate the full production cost impact by applying a congestion cost multiplier to modeled PCS; we can derive congestion cost multipliers by comparing LBMP differentials in MAPS to futures markets (*see next slide*)

V.B. Additional Production Cost Savings

PCS Multipliers from Energy Futures Prices

Market expectations relative to MAPS: Calculated multipliers for each solution based on zonal electricity (LBMP) futures prices, which theoretically reflect the full range of extreme conditions anticipated by the market, including extremes not experienced during the 2005-2014 period over which we examined historical costs

- Tx PCS multiplier calculated based on comparison of the differential between Zone A and Zone G LBMPs in MAPS 2019 Base Case to the price differential in futures for 2017/18 (Note: Zones A and G were selected for assessing the impact of UPNY/SENY, which is roughly Zone F to Zone G, and LBMP futures are not available for all zones)
- Generation PCS multiplier calculated based on ratio of market heat rate spreads (MHR – 7,000 Btu/kWh) between modeled results and futures for Zone G
- REV PCS multipliers calculated based on difference in LBMPs between modeled results and futures prices for Zones GHI or for Zone J (depending on resources' locations)

Source	Transmission Multiplier			Gen Multiplier	REV Multiplier	
	Zone A LBMP ($/MWh)	Zone G LBMP ($/MWh)	Differential ($/MWh)	MHR Spread (Btu/kWh)	REV Avg LBMP ($/MWh) Zone GHI	Zone J
Futures (2017/18)	$35.9	$46.3	$10.4	~4,040	$46.3	$48.3
MAPS (2019)	$38.0	$44.6	$6.6	~3,250	$44.6	$45.5
Futures/MAPS Ratio			**1.56**	**1.24**	**1.03**	**1.06**

Note: The Base Case MAPS run shown here is without CPV Valley, as our "multiplier" analysis was completed in March 2015, before CPV's announcement.

Historical Data Alternative Approach to Tx PCS Multiplier

As a check, we compared historical congestion costs under normal/idealized system conditions to congestion costs under a range of circumstances

To account for the fact that MAPS does not include transmission outages or departures from normalized future conditions, we evaluated:

- Effect of Transmission Outages
  - Compared MAPS 2013 backcasts with and without transmission outages
  - An accurate representation of transmission outages results in an 18% increase in demand congestion (multiplier of **1.18**)
- Effects of Extremes
  - Calculated how much the average of the annual TCC Fund increases with the inclusion of years with “extreme” supply/demand/transmission congestion conditions
  - Data on drivers of congestion costs over 2005-2014 suggest that 2007, 2008, and 2012 should be excluded from the “normal” years’ average
    - Average annual TCC Fund (congestion rents) over 2005-2014 was $561 m
    - The average excluding 2007, 2008, and 2012 was $484 m
  - This yields a multiplier of $561 m/ $484 m= **1.16**
- Combined Historical-Based PCS Multiplier= **1.18 x 1.16 = 1.4**

…but we used the slightly higher futures-based multiplier to be consistent with the multipliers for generation and REV; we examine lower multipliers in sensitivity analyses

PCS Sensitivities

We assessed the sensitivity of the estimated production cost savings to variation in the multiplier and to the assumed growth rate of savings beyond 2024

For transmission and generation:

- Higher value sensitivity: Increased PCS annual escalation rate by 1% after 2024 to capture potential effect of fuel escalation and tightening markets beyond what is conservatively included in MAPS analysis
  - Multiplier is based on first 5 years, when system is not as tight as projected in the future
  - Future likely more sensitive to Tx outages/other extremes, compounded by higher RCPFs
  - Calculated multiplier based on whole LBMP differential, rather than just the MCC differential
- Lower value sensitivity: Reduced PCS multipliers on MAPS results
  - 1.2x multiplier for transmission, representing only the Tx outage effect
  - This lower multiplier could also account for the uncertain relationship between PCS and congestion savings (the mean average percentage error in that relationship is 16%)
  - Scaled generation PCS multiplier by similar ratio to ~1.09

For REV resources:

- Higher value sensitivity: used load-weighted average instead of simple average LBMPs
- Lower value sensitivity: reduced energy savings to reflect 65% capacity factor (closer to that implied for Zone J "energy program impacts" in Gold Book), rather than ~75% assumed in GEIS

MAPS Analysis: Summary

Present Value of Production Cost Savings

Solution	MAPS 2019 PCS ($m)	MAPS 2024 PCS ($m)	PCS Multiplier	Total 2019 PCS ($m)	Total 2024 PCS ($m)	Production Cost Savings (2015 $m)
P6 NYTO	$8	$17	x 1.56	$12	$26	$221
P7 NYTO	$7	$15	x 1.56	$12	$23	$194
P9 NYTO	$9	$20	x 1.56	$15	$31	$262
P11 NYTO	$28	$36	x 1.56	$44	$57	$516
P12 NYTO	$30	$39	x 1.56	$47	$61	$554
P14 NYTO	$30	$39	x 1.56	$47	$60	$547
P19a NextEra	$8	$17	x 1.56	$12	$26	$221
P20 Boundless	$3	$10	x 1.56	$5	$16	$128
P21 Boundless	$3	$9	x 1.56	$5	$14	$115
REV Resource	$208	$331	GHI: x 1.03 J: x 1.06	$218	$348	$1,943

Note: MAPS PCS listed here are NYCA-wide Adjusted Production Costs savings

Contents

Overview of ICAP Analysis

Quantify impacts to capacity costs, prices, and payments over the life of the facilities

- **Base Case**
  - Reflects planned capacity additions and retirements in MAPS through 2024, including updated "Net Purchases" from 2015 Gold Book and likely market response to CPV Valley addition in Zone G (*see next slide*)
  - Adds new capacity when market prices rise to CT Net CONE specific to the capacity zone, such that LCRs and IRM are achieved in all years modeled (*see slide 94*)
  - Models every year over expected lifetime of proposed solutions (up to 45 years)
- **Change Cases to analyze solutions**
  - Key assumptions for each solution type:
    - For Transmission, we adjust the LCRs within the import-constrained zones based on NYISO evaluation of each solution (we made no adjustments to IRM)
    - For Generation, we increase supply in Zone G by 1,320 MW
    - For REV, we reduced the peak load forecast in each zone (*see slide 9*)
  - Methodology for estimating Change Case clearing prices/quantities for each resource over time is described on slide 95
- **Scenarios and sensitivities**
  - Evaluated sensitivity of results to several factors, including supply uncertainty, supply curve slope assumptions, and discount rate (discount rate has largest impact on results)
  - Sensitivity case of 1,000 MW and 2,000 MW retirement in SENY is similar to near-term potential retirement scenarios

V.C.1. Capacity Value: Approach

Base Case Supply Adjustments

In addition to the adjustments to 2014 Gold Book supply described in the MAPS section (*see slide 55*), we incorporated additional adjustments for ICAP modeling, including updates to capacity exports to ISO-NE and the supply response to the introduction of CPV Valley

Capacity Exports to ISO-NE:

- Projection of Net Purchases/Sales of capacity with neighboring regions in 2014 Gold Book did not account for NY resources selling their capacity into ISO-NE's Forward Capacity Market
- 2015 Gold Book projects about 1,000 MW lower Net Purchases/Sales in 2015-2018 than the 2014 version after accounting for NY resources selling into ISO-NE through 2018/19 (FCA9)
- Based on ISO-NE capacity supply obligation data for FCA9, we assume in 2019 (and each subsequent year) that there will be 510 MW less supply in Zone G-J (due to Roseton's capacity supply obligation in ISO-NE) and 540 MW less supply in UPNY

Price Response to CPV Valley:

- Adding 670 MW in zone G will reduce capacity prices in both G-J and NYCA and likely result in the retirements of existing units
- To estimate the response to lower prices, we modeled an additional 670 MW of supply in Zone G, letting the market re-equilibrate where a shifted (but sloped) supply curve intersects demand
- This indicates the exit of 150 MW in G-J and 160 MW in UPNY, which we assume exits permanently
- We incorporate this response into our ICAP Base Case from which we estimate the impacts of new Tx

Sources for Capacity Exports: 2014 Gold Book, Table V-1: Summary of Transactions External to NYCA, p. 73; 2015 Gold Book, Table V-1: Summary of Net Purchases from External Control Areas, p. 77.

V.C.1. Capacity Value: Approach

Quantifying ICAP Value – Metrics

CARIS ICAP Metrics: Calculated Variant 1 and Variant 2 metrics based on the approach used in CARIS**,** which represents potential impact on capacity payments

- *Variant 1*: From a long-term perspective, assumes supply is perfectly elastic such that the market will clear at the same price but at a lower quantity
- *Variant 2*: From a short-term perspective, assumes supply is perfectly inelastic such that quantity is constant but the prices fall

Capacity Resource Cost Savings: Developed additional metric for quantifying capacity resource cost savings in the ICAP market (not treating price suppression as a benefit or price increases as a dis-benefit) that is consistent with (and additive to) the production cost savings benefits in the energy market

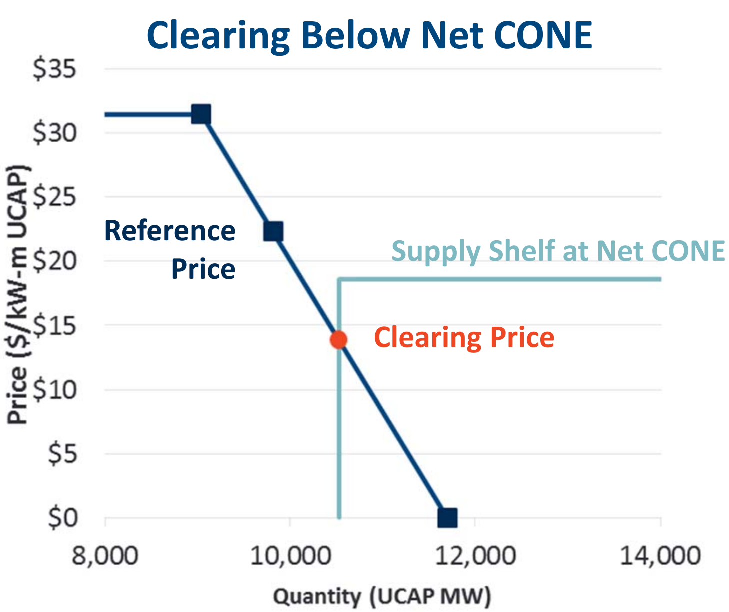
- Capacity resource cost savings arises from being able to:
  - Maintain less existing capacity in SENY, valued at quantity released times the cost of maintaining such resources (with a slight offset by adding a little UPNY capacity at the margin and incurring resource costs)
  - Delay new construction in SENY by better utilizing UPNY surplus, valued at the quantity of new construction avoided times the Net CONE in SENY (again, with a slight offset for UPNY capacity)
  - When new construction is needed, some new construction shifted to UPNY where Net CONE is lower, valued at the Net CONE differential times the quantity shifted
- Estimated using a detailed multi-zonal clearing model of the ICAP market
- Result is similar to Variant 1, but slightly lower because it accounts for diminishing marginal value of reducing capacity and NYCA clearing slightly more capacity when SENY capacity contracts

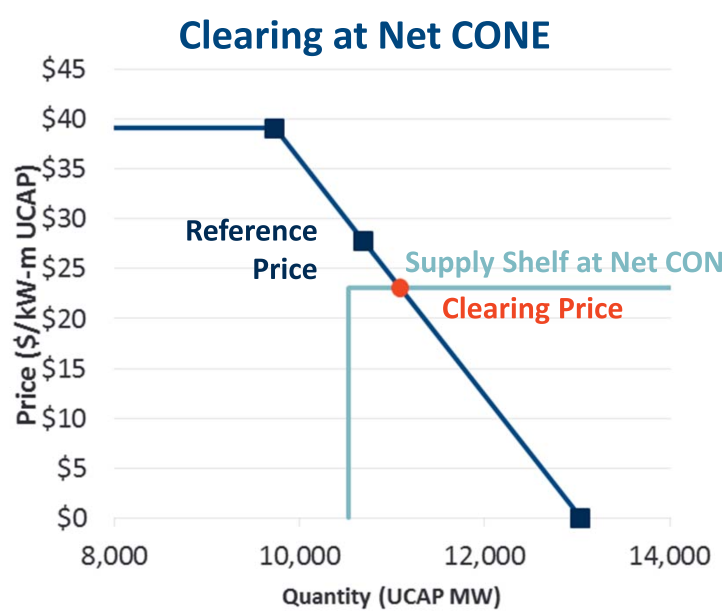
V.C.1. Capacity Value: Approach

Approach to ICAP Base Case

Modeled the NYISO ICAP market under the Base Case assuming inelastic supply until prices reach Net CONE

- Demand curves use the current IRM/LCR percentages and the latest NYISO load forecast
- Supply curve is vertical based on projected capacity in Base Case with shelf at Net CONE
- Model clears the market based on the supply and demand curves, while accounting for nested zonal structure (for example, prices in subzones cannot fall below the parent zone)
- We adjust parent zone supply following years in which supply is added to nested zones to meet LCR to be consistent with Change Case

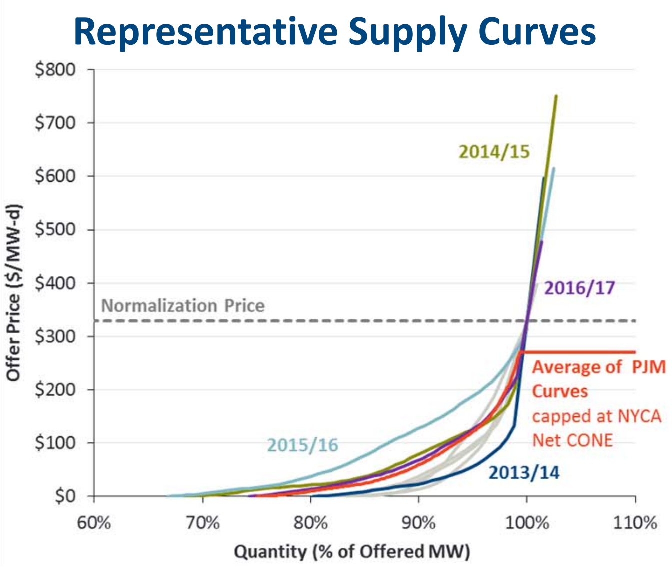


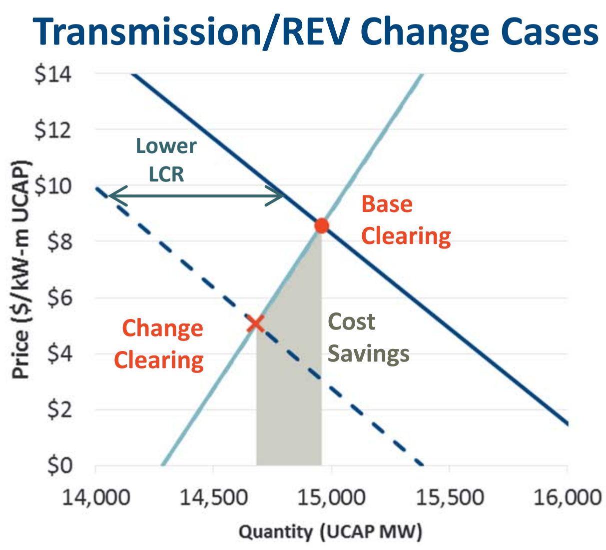


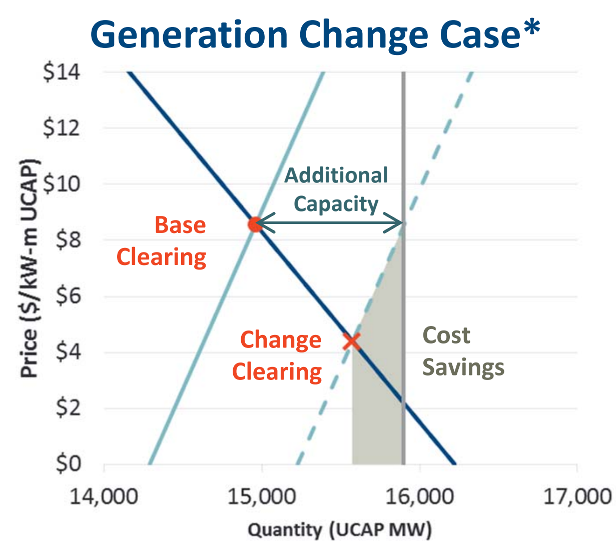
Modeling Change Cases

Change Cases result in different outcomes in the ICAP market due to shifts in the demand curve (for transmission and REV solutions) and the supply curve (for generation) and the assumed slope of the supply curve

- *Supply Curves*: Generated representative curve based on bids from past three PJM auctions
- *Transmission/REV*: Demand curve shifts to the left based on LCR impact or peak load reduction, resulting in lower prices, reduced capacity procured, and capacity cost savings
- *Generation*: Treated as inframarginal supply shifting curve right, which lowers prices and quantities procured from other resources (**Note*: we do not add generation into the ICAP market until price reaches Net CONE, due to buyer-side mitigation)







V.C.1. Capacity Value: Approach

Other ICAP Model Assumptions

Annual vs. Seasonal Markets: Created a single annual market using the average of summer/winter ICAP/UCAP translation factors to draw demand curve

Demand Curve Slopes: Assume demand curve slopes do not change after 2015

Peak Load Growth: For 2025 – 2063, we assume peak load in each zone grows at the average projected annual growth rate for 2020 – 2025

No Attrition of Existing Supply except in response to lower capacity prices in the Change Case or in response to capacity addition in sub-zones

Impact energy losses on peak load: Analysis of changes in energy losses during the top 100 load hours resulted in an inconclusive pattern of changes across portfolios; therefore, assume no impact of energy losses on peak load and IRM

Impact of changes in E&AS revenues on Net CONE: Adjusted E&AS margins by -\$0.2/kW-mo to +\$0.1/kW-mo (depending on zone and portfolio/resource) based on changes in CT revenues from 2019 and 2024 MAPS results; assume Net CONE is constant in real terms after 2024

V.C.1. Capacity Value: Approach

ICAP MW Impact of Tx Portfolios

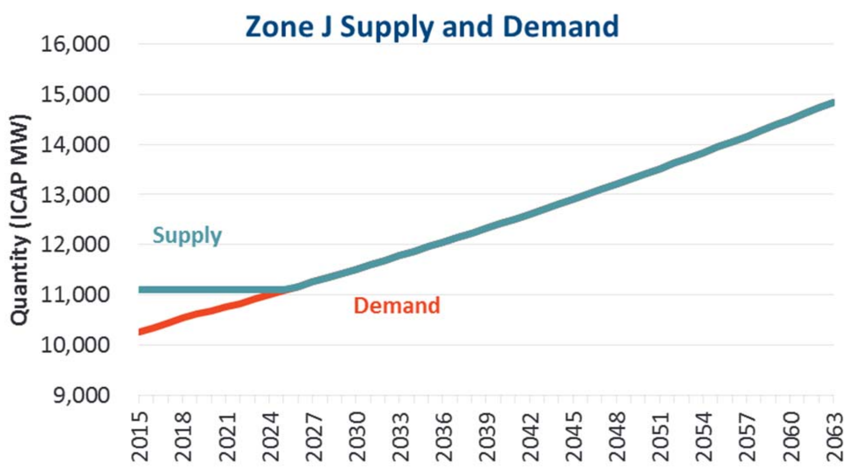
With NYISO staff, we developed an approach to estimate the Tx portfolios' impacts on LCRs

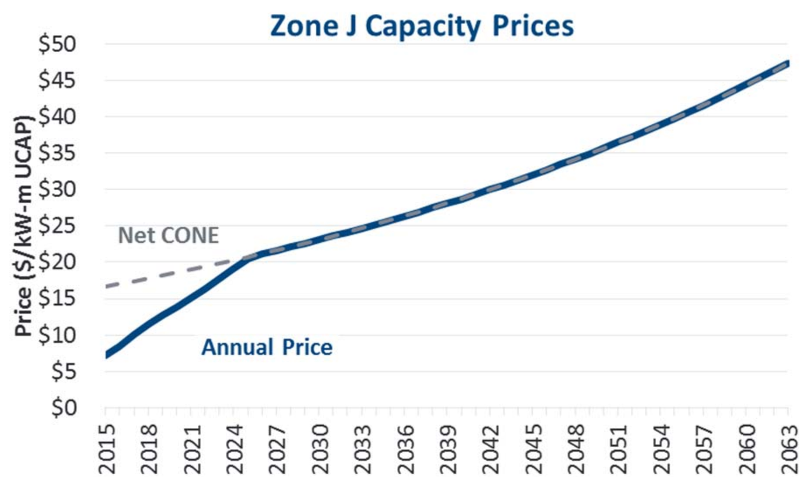
- Using GE-MARS, start with a 2024 base case, note the LOLEs (close to 0.1), then increase interface limits
- For J and K's LCR impacts, follow the CARIS tariff method by proportionally removing capacity from all zones until LOLE returns to the base level; the amount removed from J & K provides a reasonable and conservative approximation of the LCR impact the more detailed TAN45 method would produce; NYSRC's IRM process also uses this methodology to analyze sensitivities
- For G-J's LCR impacts, hold J and K at the capacities from the prior step but restore zones A-I to the base level; then shift capacity proportionally from GHI to A-F until LOLE returns to the base level; the amount of capacity shifted out of GHI in this step plus capacity removed from J in the prior step indicates the transmission portfolio's ability to lower the G-J LCR
- For NYCA's IRM, we conservatively assume no impact based on previous NYISO analysis of similar transmission projects using the TAN45 method

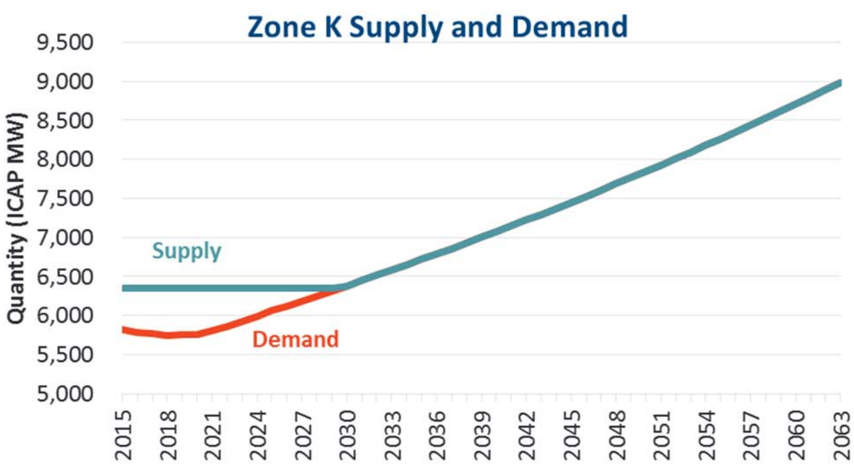
Proposed Solution	UPNY/SENY Emergency N-1 Impact (MW)	NYCA IRM Impact (MW)	Zone G-J LCR Impact (MW)	Zone J LCR Impact (MW)	Zone K LCR Impact (MW)
P6 NYTO	+1,686	0	-1,017	-213	-125
P7 NYTO	+1,404	0	-911	-209	-123
P9 NYTO	+2,091	0	-932	-213	-125
P11 NYTO	+1,621	0	-1,087	-217	-127
P12 NYTO	+1,341	0	-1,079	-217	-127
P14 NYTO	+2,286	0	-1,107	-217	-127
P19a NextEra	+1,747	0	-935	-213	-125
P20 Boundless	+1,753	0	-904	-211	-124
P21 Boundless	+1,433	0	-895	-211	-124

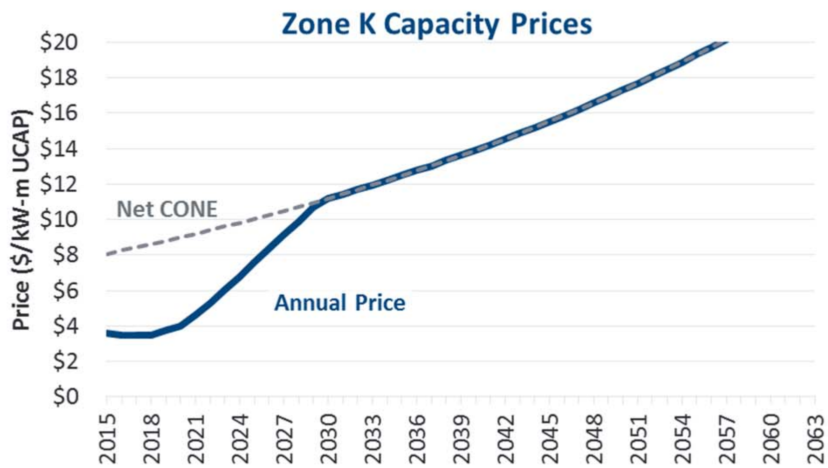
Contents

V.C.2. Capacity Value: Results
Base Case Supply, Demand & Prices



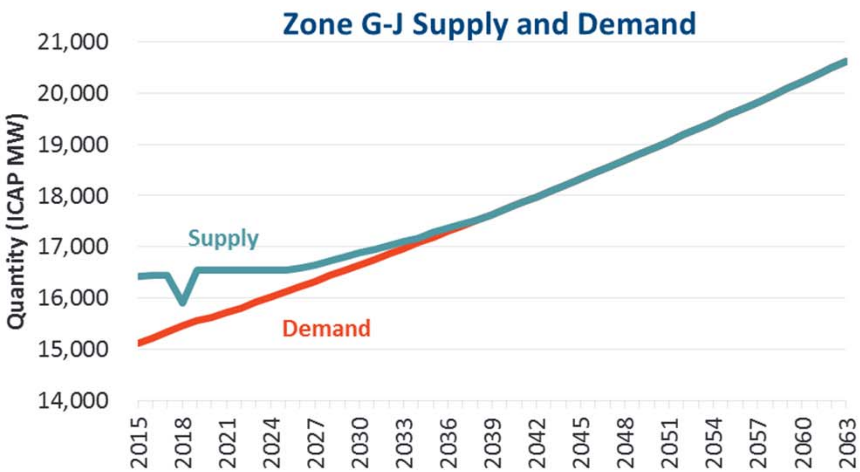


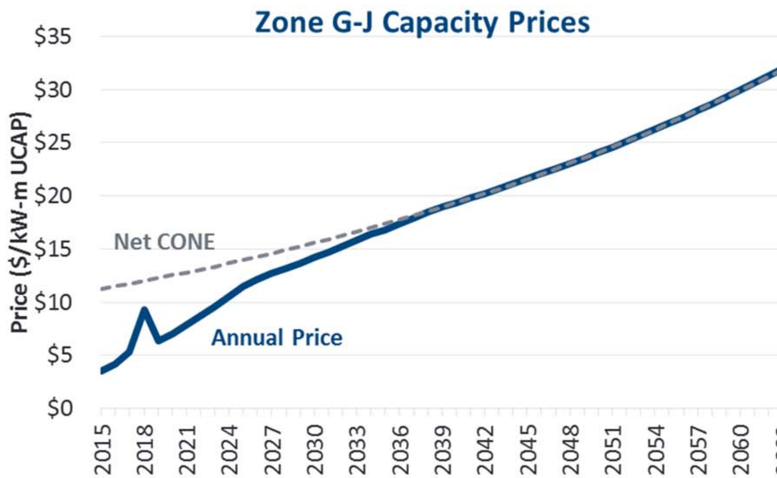


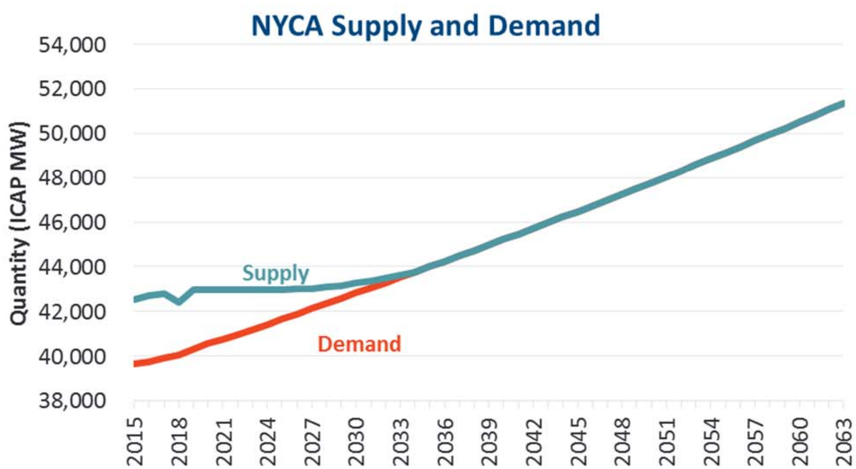


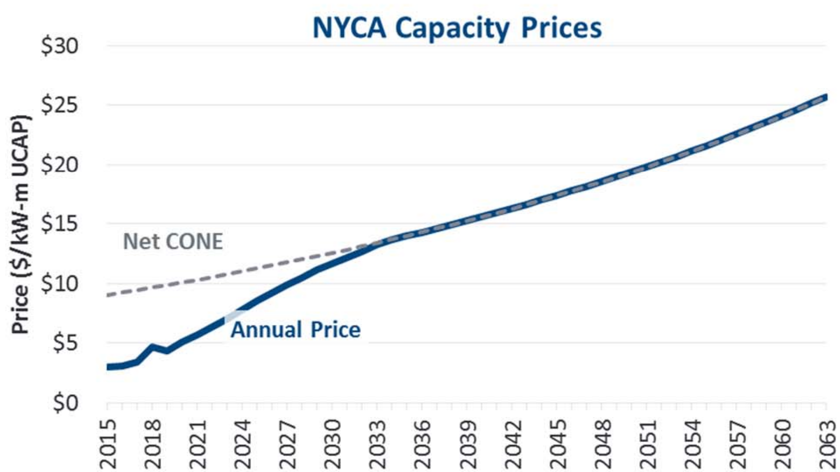
Note: "Demand" indicates the quantity where price is Net CONE, which is above the LCR

Base Case Supply, Demand & Prices (cont.)







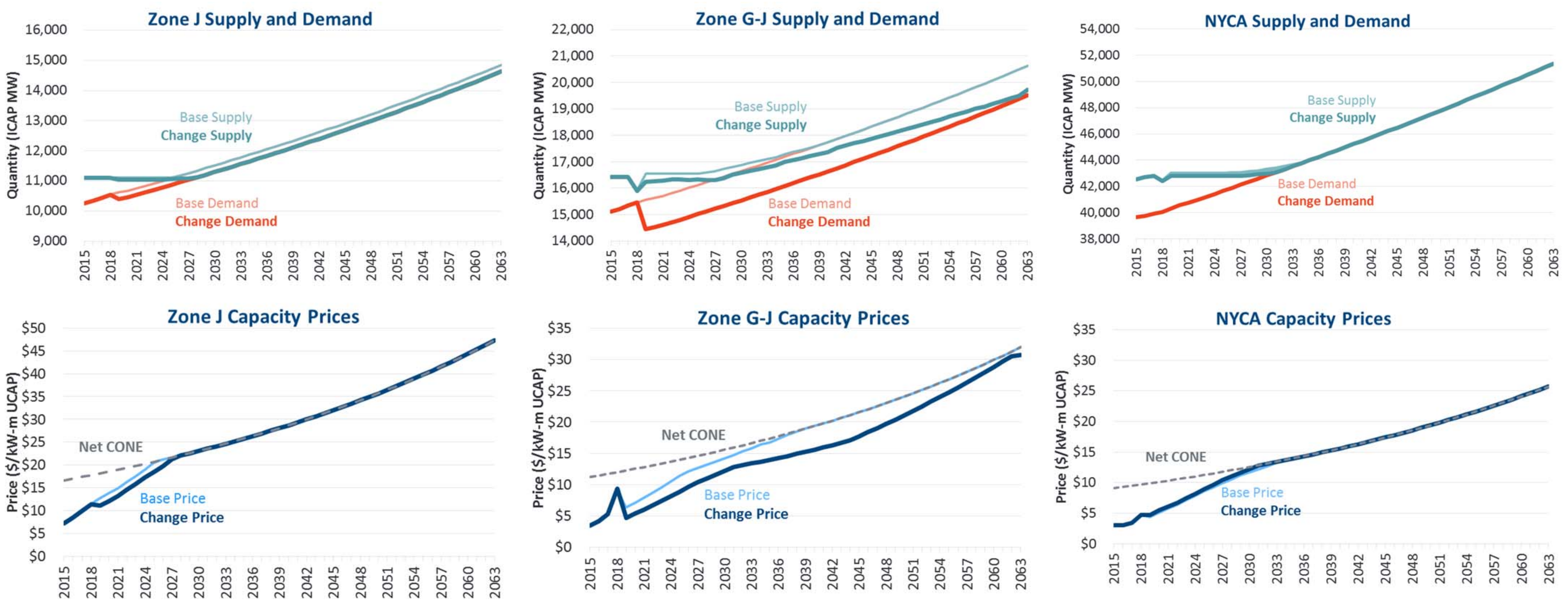


Note: "Demand" indicates the quantity where price is Net CONE, which is above the LCR

V.C.2. Capacity Value: Results
Change Case Supply, Demand & Prices

To demonstrate the Change Case, we show that P14, for example, has the following impacts on clearing prices and capacity:

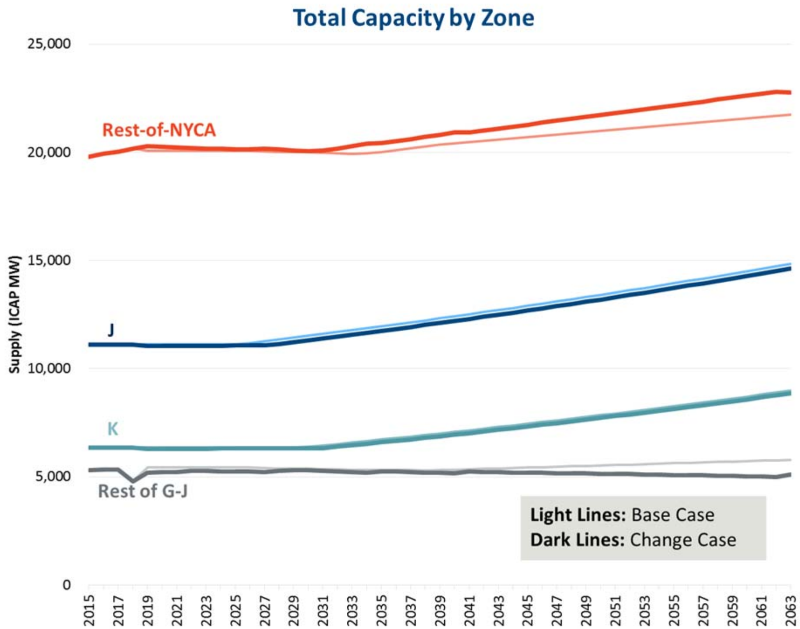
- Decreased demand in Zones J, G-J and K (not shown) results in lower prices and capacity cleared
- Reduced SENY capacity results in higher prices in NYCA and increased capacity in rest-of-NYCA

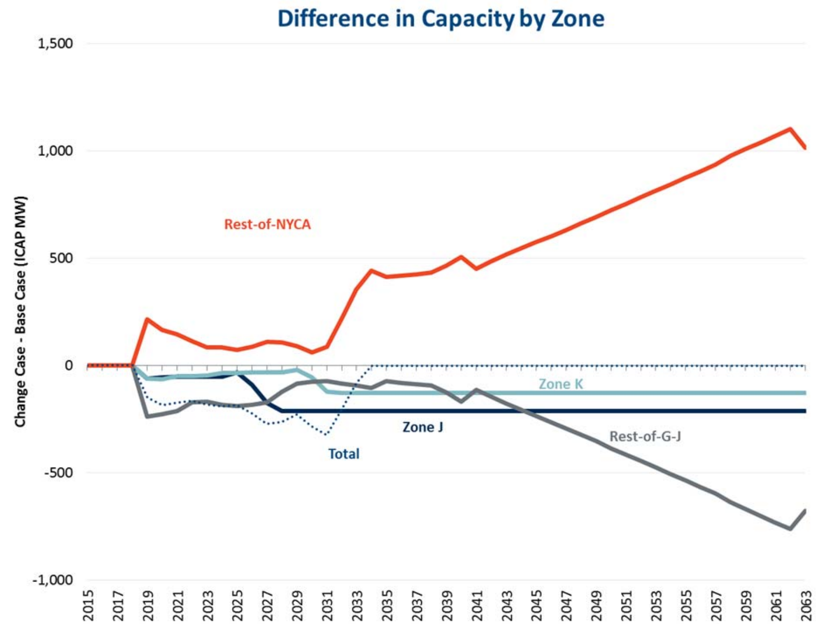


Supply in Base and Change Cases

To better demonstrate the differences in Base and Change Case in ICAP, we show total capacity and change in capacity by area (isolating "Rest-of-NYCA" and "Rest of G-J")

- As expected, capacity in SENY areas decreases and capacity in UPNY increases
- Total capacity is lower in the Change Case until both cases in 2034 reach Net CONE in NYCA
- After 2034, high-cost capacity in G-J is replaced 1-for-1 by low-cost capacity in Rest-of-NYCA
- Capacity cost savings are achieved due to the change in the amount and location of supply resources in the Change Case



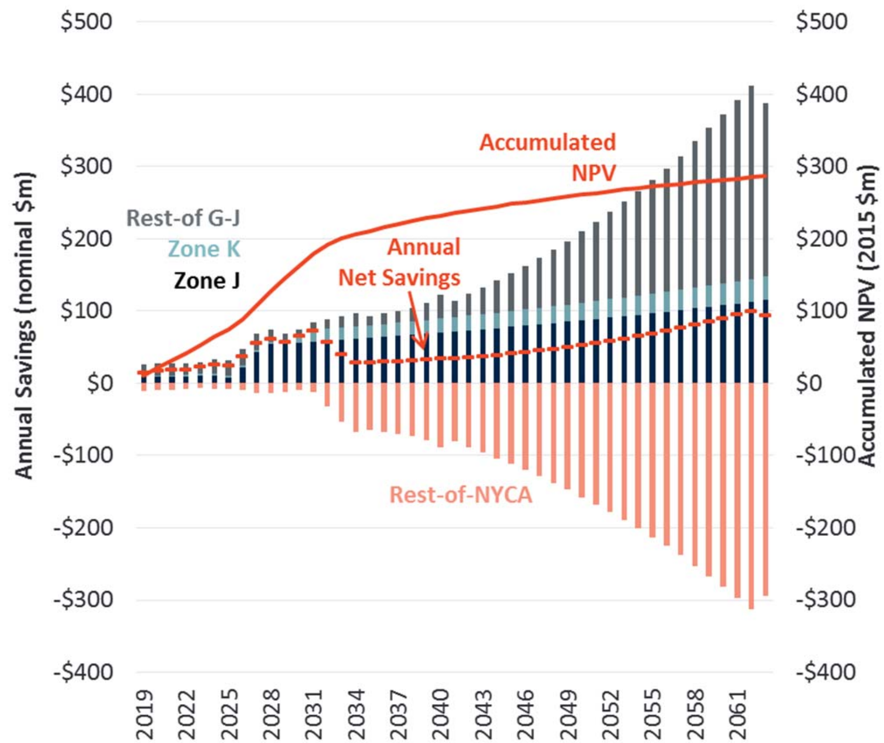


Note: Diagrams show adding ~1,000 MW of transfer capacity into G-J results in 450 MW shift in capacity from SENY to UPNY, based on the assumed slope of the supply curves. If in fact SENY has more expensive capacity that leaves (and reaches equilibrium faster, as assumed in the ratepayer impact analysis), the resource shifts between G-J and NYCA would be greater than shown in this analysis and result in greater resource cost savings.

Transmission Solution Capacity Value

We estimated NPV of capacity cost savings for the P14 NYTO to be $286m

- In Zone J, the lower LCR leads to capacity savings of $8m in 2019 due to reduced capacity cleared
- The transmission solution has a similar impact on Zone K, resulting in $2m in 2019 savings
- In G-J, less capacity is needed because of the lower LCR (which is offset slightly by reduced supply in Zone J) which leads to 2019 savings of $15m
- To make up for lost G-J capacity and still maintain IRM, capacity must be added in Rest-of-NYCA, which offsets the savings in other zones by $11m in 2019



We estimated the capacity value of the other Tx portfolios, Generation and REV Resources in a similar way

Summary of Capacity Value

For each proposed solution, we also calculated the CARIS Variant 1 and Variant 2 metrics following the approach outlined in CARIS Appendix E

Solution	Capacity Resource Cost Savings (2015 $m)	CARIS Variant 1 (2015 $m)	CARIS Variant 2 (2015 $m)
P6 NYTO	$284	$306	$857
P7 NYTO	$284	$305	$876
P9 NYTO	$286	$307	$869
P11 NYTO	$286	$309	$883
P12 NYTO	$286	$308	$894
P14 NYTO	$286	$309	$896
P19a NextEra	$285	$305	$839
P20 Boundless	$288	$308	$894
P21 Boundless	$288	$308	$892
Generation (25 yr)*	$89	$94	$45
REV Resource Solution	$613	$692	$3,468

Note: Generation capacity value is reduced due to the MOPR

Sensitivity of Capacity Value

The capacity value of the proposed solutions depends on assumptions about the supply curves and the discount rate used to calculate NPV

- **Supply Curve Slope**: Adjusting the estimated slopes of the supply curves by +/- 25% impacts the results for Tx portfolios by **-$11m to +$16m** (-4% to + 6%) on average
- **Discount Rate:** Applying a discount rate of 5.58% increases the value by **$230m**(+79%) on average for the Tx portfolios

Uncertain Capacity Retirements: Capacity value of new Tx depends on excess UPNY capacity being available as well as the difference in Net CONE between UPNY and SENY; for this reason, we analyzed the change in capacity value across the following conditions

Scenario	Average Impact on Capacity Value ($m)
2,000 MW Retires in SENY	+$420
1,000 MW Retires in SENY	+$245
1,000 MW Retires in UPNY	-$100
2,000 MW Retires in UPNY	-$160

Response to CPV Valley: If a 500 MW generation facility in Zone G retires in response to the announced addition of CPV Valley *instead of* the response we estimated (*see slide 92*), the transmission portfolios would save *an additional* $70m in capacity resource costs

V.C.2. Capacity Value: Results

Capacity Market Ratepayer Impacts

Calculated ratepayer impacts based on results of ICAP market model

- Model projects changes in cleared quantity and prices due to Tx solutions, which for 2019 finds:
  - NYCA: Increased capacity cleared at higher prices results in increased payments
  - SENY Zones: Decreased capacity cleared at lower prices results in decreased payments
- NYCA payments allocated to UPNY and SENY ratepayers based on load ratio share
- All other zones 100% allocated to SENY ratepayers

2019 ratepayer impact for P14 is:

- UPNY: *Increases* by 0.073 c/kWh
- SENY: *Decreases* by 0.370 c/kWh

2019 Capacity Market Ratepayer Impact for P14

Region Case	Cleared Quantity *MW*	Cleared Price *$/kW-mo*	Cleared Payments *$m*	UPNY Payments *$m*	SENY Payments *$m*
NYCA					
Base Case	17,980	$4.4	$942	$718	$224
Change Case	18,184	$4.7	$1,021	$766	$254
Difference	**204**	**$0.3**	**$79**	**$49**	**$30**
Zone G-J					
Base Case	5,104	$6.4	$390	-	$390
Change Case	4,879	$4.7	$274	-	$274
Difference	**-225**	**-$1.7**	**-$116**	**$0**	**-$116**
Zone J					
Base Case	10,524	$12.8	$1,611	-	$1,611
Change Case	10,465	$11.1	$1,396	-	$1,396
Difference	**-59**	**-$1.6**	**-$216**	**$0**	**-$216**
Zone K					
Base Case	5,839	$3.8	$265	-	$265
Change Case	5,781	$3.3	$226	-	$226
Difference	**-58**	**-$0.5**	**-$40**	**$0**	**-$40**
Total Payments ($m)				**$49**	**-$342**
Ratepayer Impact (c/kWh)				**0.073**	**-0.370**

Note: Cleared Quantity represents capacity that is specific to each region, such that NYCA's Cleared Quantity only accounts for capacity that did not clear in G-J, J, or K.

V.C.2. Capacity Value: Results

Maintaining Reliability with Major Retirements

In addition to reduced capacity costs, the additional transfer capability into SENY provided by the Tx solutions will increase the flexibility to accommodate generation retirements without falling below LCRs

Additional Capacity Retirement Flexibility of Proposed Solutions (MW)

Proposed Solution	Zone G-J (MW)	Zone J (MW)	Zone K (MW)	Total (MW)
P6 NYTO	1,017	213	125	**1,142**
P7 NYTO	911	209	123	**1,034**
P9 NYTO	932	213	125	**1,057**
P11 NYTO	1,087	217	127	**1,214**
P12 NYTO	1,079	217	127	**1,206**
P14 NYTO	1,107	217	127	**1,234**
P19a NextEra	935	213	125	**1,060**
P20 Boundless	904	211	124	**1,028**
P21 Boundless	895	211	124	**1,019**

Note: Total is calculated based on sum of G-J and K since J is nested in G-J.

Contents

Types of Avoided Transmission Costs

Concept: Proposed projects may avoid future Tx costs in four ways:

1. Upgrading Existing Lines: Projects that reconductor, retire, rebuild, or replace existing lines incur new O&M and property taxes, but if counting those has "new" costs, need to recognize that the "old" costs associated with existing facilities go away
2. Early Refurbishments of Aging Lines: Projects that replace aging lines identified in STARS and confirmed by project proponents avoid the cost of replacing those lines in the future
3. Parallel Facilities Could Reduce Congestion Costs During Refurbishment: Projects that add new parallel paths to aging lines will reduce congestion and production costs during construction
4. Parallel Facilities Reduce Refurbishment Costs: Projects that add new parallel lines to aging lines will also lower the cost of future refurbishments by avoiding expensive construction scheduling when taking the existing lines out of service for construction. (We analyze this only as a sensitivity.)

Approach: Benefits of each portfolio depend on whether they replace existing or aging facilities and/or provide additional parallel path to aging facilities:

- All nine Tx portfolios include an upgrade of existing lines that will avoid future costs
- P6, P9, P11, P12, P14, and P19a replace aging facilities, avoiding future costs; also likely to cause congestion during construction, but similar to Base Case (therefore, no net "dis-benefit")
- P4, P9, P17, P19a provide additional parallel paths, which could avoid congestion costs (depending on the aging lines); they could also avoid a premium on extended refurbishment schedule, but we include this benefit only as a sensitivity

V.D. Avoided Transmission Costs

Summary of Avoided Transmission Costs

<table>
<tr><th>Type of Project Elements</th><th>Avoided “Base Case” Cost*</th><th>Approach to Quantifying</th><th>P6 NYTO ($m)</th><th>P7 NYTO ($m)</th><th>P9 NYTO ($m)</th><th>P11 NYTO ($m)</th><th>P12 NYTO ($m)</th></tr>
<tr><td>Project Elements Upgrade Existing Lines</td><td>Ongoing O&M costs</td><td>Credit equals the present value of the avoided revenue requirements of existing lines upgraded (Note: Cost only avoided until date line planned to be refurbished in Base Case, if refurbished at all.)</td><td>$87m
Replace KN-PV</td><td>$70m
Reconductor LD-PV</td><td>$112m
Reconductor NS-LD and replaces LD-PV</td><td>$65m
Retire PT-RM and replaces LD-PV</td><td>$135m
Retire PT-RM and reconductor NS-LD and LD-PV</td></tr>
<tr><td>Project Elements Replace Aging Lines that will have to be replaced anyway</td><td>Future Refurbishment costs</td><td>Credit equals the present value of future revenue requirements for refurbishments. (Note: Date indicates when we assume refurbishment would occur in Base Case.)</td><td>$195m
Replace KN-PV (2030)</td><td>-</td><td>$148
Replace LD-PV (2030)</td><td>$933
Retire PT-RM (2020) and replace LD-PV (2030)</td><td>$739
Retire PT-RM (2020)</td></tr>
<tr><td rowspan="3">Project Elements Provide Parallel Paths to Aging Lines that will have to be replaced in the future</td><td>Congestion during Construction</td><td>Aging lines are predominantly 115 kV rated, and were expected to have very low production cost/congestion impact</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">Construction Costs due to Extended Construction Schedule</td><td>Base Analysis conservatively assume no costs avoided</td><td>$0</td><td>$0</td><td>$0</td><td>$0</td><td>$0</td></tr>
<tr><td>Sensitivity Analysis
avoid 20% of costs due to normal construction schedule; credit equals the present value of future revenue requirements for refurbishments</td><td>$91
Avoids costly constr. of 6 115kV Lines in LD-PV Corridor</td><td>–</td><td>$91
Avoids costly constr. of 6 115kV Lines in LD-PV Corridor</td><td>$91
Avoids costly constr. of 6 115kV Lines in LD-PV Corridor</td><td>–</td></tr>
</table>

[*] Assumes “Base Case” world needs to refurbish aging lines in the latest years indicated in STARS, incurring capital costs at that time; Project change cases show differences in costs from that Base Case

Summary of Avoided Transmission Costs (2)

Type of Project Elements	Avoided "Base Case" Cost*	Approach to Quantifying	P14 NYTO ($m)	P19a NextEra ($m)	P20 Boundless ($m)	P21 Boundless ($m)
Project Elements Upgrade Existing Lines	Ongoing O&M costs	Credit equals the present value of the avoided revenue requirements of existing lines (*Note: Cost only avoided until date line planned to be refurbished in Base Case, if refurbished at all.*)	**$108m** Retire PT-RM, reconductor NS-LD and replace CH-PV	**$41m** Replace GB-PV	**$157m** Reconductor LD-PV, HA-LD, and CPV-RT	**$76m** Reconductor HA-LD, and CPV-RT
Project Elements Replace Aging Lines that will have to be replaced anyway	Future Refurbishment costs	Credit equals the present value of future revenue requirements for refurbishments (*Note: Date indicates when we assume refurbishment would occur in Base Case.*)	**$887** Retire PT-RM (2020) and replace LD-PV (2030)	**$223m** Replace GB-PV (2030)	-	-
Project Elements Provide Parallel Paths to Aging Lines that will have to be replaced in the future	Congestion during Construction	Aging lines are predominantly 115 kV rated, and were expected to have very low production cost/congestion impact	–	–	–	–
	Construction Costs due to Extended Construction Schedule	**Base Analysis** conservatively assume no costs avoided	**$0**	**$0**	**$0**	**$0**
		Sensitivity Analysis avoid 20% of costs due to normal construction schedule; credit equals the present value of future revenue requirements for refurbishments	**$91** Avoids costly constr. of 6 115kV Lines in LD-PV Corridor	**$91** Avoids costly constr. of 6 115kV Lines in LD-PV Corridor	–	–

[*] Assumes "Base Case" world needs to refurbish aging lines in the latest years indicated in STARS, incurring capital costs at that time; Project change cases show differences in costs from that Base Case

Upgrades to Existing Lines

Portfolios should be credited for upgrading existing facilities

- Many of the portfolios upgrade existing facilities by either reconductoring, rebuilding, or replacing them
- Although the upgrades may not be "needed," the ongoing RevReqs for those facilities to cover O&M costs and property taxes will be replaced by the RevReqs for the proposed facilities
- For that reason, we include the RevReq of the existing facilities proposed to be upgraded as avoided costs and include them as a benefit

Approach to calculating the credit (to partially offset the full cost of the portfolio that is taking over the existing facility)

- DPS identified the existing lines that are proposed to be upgraded and provided the replacement costs for each line segment
- We calculated avoided O&M costs by multiplying the existing line replacement costs by 2.9%, the assumed O&M costs as a percentage of capital costs in the RevReq workbook provided by DPS (*see slide 46*)
- We calculated avoided property taxes by converting replacement costs to assessed value and multiplying by the assumed property tax of 2.18% (*see slide 46*)
  - For societal benefit-cost analysis, the avoided taxes net to zero against reduced receipts
  - For the ratepayer impact analysis, we recognize the avoided tax burden

Existing Lines Proposed to be Upgraded

Tx Portfolio	Facility Upgraded	Type of Upgrade	Assumed Refurbishment Year	Replacement Costs (2015 $m)	PVRR of Avoided Costs (2015 $m)
P6 NYTO	KN - PV 115 kV	Replaced	2030	$484	**$87**
P7 NYTO	LD - PV 115 kV	Reconductor	N/A	$214	**$70**
P9 NYTO	NS - LD 115 kV	Reconductor	N/A	$171	**$112**
	LD - PV 115 kV	Replaced	2030	$313	
P11 NYTO	PT - RM 230 kV	Retired	2020	$396	**$65**
	LD - PV 115 kV	Replaced	2030	$313	
P12 NYTO	PT - RM 230 kV	Retired	2020	$396	**$135**
	NS - LD 115 kV	Reconductor	N/A	$171	
	LD - PV 115 kV	Reconductor	N/A	$214	
P14 NYTO	PT - RM 230 kV	Retired	2020	$396	**$108**
	NS - LD 115 kV	Reconductor	N/A	$171	
	CH - PV 115 kV	Replaced	2030	$242	
P19a NextEra	GB - PV 115 kV	Replaced	2030	$230	**$41**
P20 Boundless	LD - PV 115 kV	Reconductor	N/A	$246	**$157**
	HA - LD 115 kV	Reconductor	N/A	$128	
	CPV - RT 115 kV	Reconductor	N/A	$107	
P21 Boundless	HA - LD 115 kV	Reconductor	N/A	$128	**$76**
	CPV - RT 115 kV	Reconductor	N/A	$107	

Notes:
Assume RevReq for existing lines would be required through 2063 unless the line is aging and projected to be refurbished in year shown (see next section for more details).
PVRR of avoided costs calculated by reducing O&M costs in RevReq workbook proportional to 1 minus the ratio of Replacement Costs over Portfolio Capital Costs and calculating the change in the RevReq.

V.D.2. Avoided Transmission Costs: Aging Lines

Early Refurbishment of Aging Lines

Concept:

- Many of the proposed projects address the need to upgrade aging transmission facilities by making early refurbishments of specific aging facilities, and thus avoiding future refurbishment costs
- We count these avoided costs (and associated revenue requirements) as benefits

Approach to Quantifying Savings :

- Identify old facilities that each project would refurbish, by reviewing proposals
- Cross reference with the 2012 STARS report to see estimated time-to-replacement
- Use DPS's estimate of the capital costs avoided at that time; then calculate present value of avoided costs and avoided RevReq
  - The costs include the cost of rebuilding an existing aging line – identified by project proponents – that would have to be refurbished in the Base Case within the next 10 – 30 years
  - The benefit credit reflects the PV of savings from not having to refurbish the line later at the estimated capital cost (from DPS)

V.D.2. Avoided Transmission Costs: Aging Lines

Key Assumptions

- STARS Report identifies aging transmission facilities based on an age criteria; it notes that a condition assessment would need to be conducted to ascertain which facilities would actually need to be refurbished
- We assumed that the project proponents have performed cursory level condition assessments to identify the facilities (lines and structures) needing refurbishment
  - Therefore, we relied on the Project Applications to identify aging facilities whose refurbishments would result in Avoided Costs
  - Only aging facilities rated 115 kV and 230 kV were identified by project proponents as facilities needing refurbishment
  - For e.g., TRANSCO's Leeds-PV Reconductoring project refurbishes 345 kV lines in the Leeds-PV corridor, which are identified by STARS report as aging, however, the TRANSCO application does not indicate those facilities need refurbishment (see quote from p. 12 of the TRANSCO Application below)

"The LD-PV Reconductoring Project increases UPNY/SENY transfers at a lower cost with few construction and environmental impacts. The Project by itself meets the full 1000 MW of UPNY/SENY transfer, though it does not improve the transfers across the Central-East interface. <u>The Project does not address any of the aging infrastructure issues nor does it add to system resiliency</u>."

V.D.2. Avoided Transmission Costs: Aging Lines

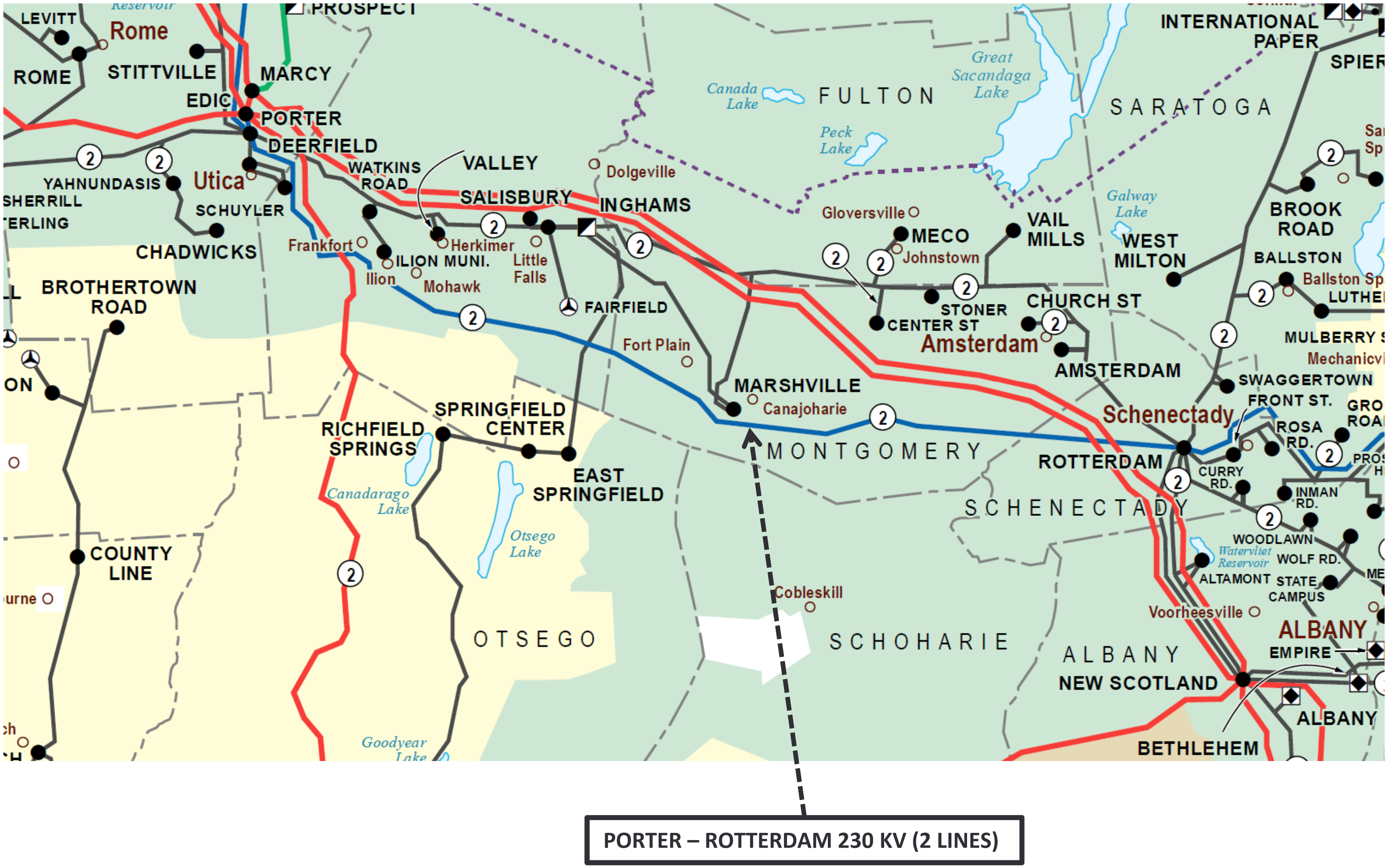
New Scotland-Leeds-Pleasant Valley Corridor

GREENBUSH – N. CHURCHTOWN – PV 115 KV (2 LINES)

LEEDS – PV 115 KV (2 LINES)

Source: NYISO 2013 Electric System Map

Central East



Source: NYISO 2013 Electric System Map

Avoided Costs of Refurbishing Aging Lines

Project	Aging Transmission Facility (identifed in STARS 2012 Report)	Estimated Year of Refurbishment	Proposed Refurbishment	Refurbishment Mileage	Avoided Capital Costs (mid-2015 $m)	Avoided Investment Cost (Mid-Year before Investment $m)	Avoided PVRR (Mid-Year before Investment $m)	Avoided PVRR (mid-2015 $m)
P6 – NYTO	Knickerbocker - Pleasant Valley 115 KV (2 lines)	2030	Replacement	108	**$279**	**$401**	**$661**	**$195**
P7 - NYTO	None		None		-	-	-	-
P9 - NYTO	Leeds - Pleasant Valley 115 kV (2 Lines)	2030	Replacement	82	**$212**	**$305**	**$502**	**$148**
P11 – NYTO	Porter - Rotterdam 230 kV (2 Lines)	2020	Retirement	140	**$560**	**$636**	**$1,048**	**$739**
	Knickerbocker - Pleasant Valley 115 KV (2 lines)	2030	Replacement	108	**$279**	**$401**	**$661**	**$195**
	Total				**$839**			**$933**
P12 – NYTO	Porter - Rotterdam 230 kV (2 Lines)	2020	Retirement	140	**$560**	**$636**	**$1,048**	**$739**
P14 – NYTO	Porter - Rotterdam 230 kV (2 Lines)	2020	Retirement	140	**$560**	**$636**	**$1,048**	**$739**
	Leeds - Pleasant Valley 115 kV (2 Lines)	2030	Replacement	82	**$212**	**$305**	**$502**	**$148**
	Total				**$772**			**$887**
P19a – NextEra	Greenbush - N. Churchtown - Pleasant Valley 115 kV (2 lines)	2030	Retirement	124	**$319**	**$459**	**$757**	**$223**
P20 – Boundless	None		None		-	-	-	-
P21 – Boundless	None		None		-	-	-	-

Notes:

Assumed lines to be replaced in STARS report in 0 – 10 years occur in 2020 and 11 – 20 years occur in 2030.

Assumed all identified aging facilities will require a full rebuild to calculate the avoided capital cost; used generic equipment cost of $2.6m for a 115 kV Tx rebuild to calculate avoided capital cost for 115 kV Lines.

See slides 46 – 47 for an explanation of how we convert 2015 overnight costs to PVRR in 2015$.

Avoided Congestion Costs

Many proposed projects add new transmission parallel to aging 115kV and 230kV lines; parallel paths could enable reduced congestion and production costs during future refurbishment of aging facilities

- We estimated that the aging 115 kV lines, which are all in the Leeds-Pleasant Valley corridor, will have very low congestion and production cost impacts
  - This was based on our MAPS analysis to estimate the congestion impact of outage of major 345kV facilities in the Leeds-PV corridor (see Appendix); congestion impact of major 345kV lines was low, at less than $2m; therefore, expected the impact of 115kV outages to be even lower
- We evaluated avoided congestion costs for the 230kV lines by modeling outages of the Porter-Rotterdam (PT-RM) 230kV aging lines in MAPS (without any parallel paths), and compared the congestion impact with our base case (the base case, which modeled the current system without outages, also represents an outage during refurbishment in the presence of a new parallel path)
- However, we do not credit projects retiring PT-RM lines with any avoided congestion cost benefits, since with the new Tx, PT-RM must be removed during construction to accommodate new lines on the same ROW; without it, PT-RM must be taken out of service during refurbishment anyway

Avoided Congestion Costs

- To estimate congestion impact during refurbishment of major 345kV lines in the Leeds-PV corridor, we modeled the outage of Athens-Pleasant Valley 345kV line in MAPS
  - 345kV lines in the LD-PV corridor were identified in the STARS report as potentially needing refurbishment, subject to more detailed condition assessments (note that project proponents however do not identify these facilities as aging; therefore, we do not count these as avoided congestion costs in our benefits analysis)
- We assumed outages of Leeds – Pleasant Valley and New Scotland – Leeds 345kV lines would have similar impacts as the Athens – Pleasant Valley outage
- In Central East, we modeled the outage of Porter – Rotterdam 230 kV lines, as some projects propose to retire these facilities
- Results indicate that congestion and production cost impacts of these outages are very low

Elements being Outaged for Replacement	Assumed Outage Required	Outage Period Assumed (modeled in MAPS)	2019 NYCA-wide APC Impact ($m)
Athens – Pleasant Valley 345 (part of UPNY/SENY)	**23 weeks (~ 6 months)**	A1. February through April	$1.60
		A2. October through December	$0.24
		Total (A1 + A2)	**$1.84**
Porter – Rotterdam 230 (part of Central East)	**10 weeks in fall, 10 weeks in spring, 6 weeks in fall**	B1. March through Mid-May	$2.69
		B2. September through Mid-November	$0.24
		Total (B1 + B2 * 1.6)	**$3.07**

New Parallel Lines Reduce Future Refurbishment Costs

Projects that provide parallel paths to existing aging lines lower the cost of future refurbishments by avoiding expensive construction scheduling when taking existing lines out of service for construction

- In the short-term, parallel lines provide flexibility to schedule maintenance outages, which we have aimed to capture already under production cost related benefits
- In the long-term, new parallel lines could reduce the construction cost of future refurbishment of aging lines
- In the New Scotland–Pleasant valley corridor, we estimate that projects might avoid 20% cost premium associated with costly extended refurbishment schedules; <u>cost premium savings are uncertain, therefore we treat this as an added benefit only in our sensitivity analysis</u>
- Even though some projects propose new parallel lines in Central-East, they require existing aging lines to be removed to accommodate new lines on the same ROW; therefore, no construction cost savings occur due to these parallel lines

V.D.4. Avoided Transmission Costs: Construction Costs

Avoided Construction Costs by Adding Parallel Line

5 of the 9 projects propose to build a new transmission line in the New Scotland–Leeds–Pleasant Valley corridor that will enable refurbishment of up to 3 aging lines

Portfolio	Facilities Proposed	Aging Lines whose Refurbishment is Enabled by Proposed Facility	Proposed Refurbishment	Estimated Year of Refurbishment	Refurbishment Mileage	Estimated Cost of Refurbishment (mid-2015 $m)	20% of Estimated Refurbishment Costs (mid-2015 $m)	Avoided Investment Costs (Mid-Year before Investment $m)	Avoided PVRR (Mid-Year before Investment $m)	Avoided PVRR (mid-2015 $m)
P6 – NYTO	**Knickerbocker - Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P7 – NYTO	**None**	-	-	-	-	-	-		-	-
P9 – NYTO	**Leeds - Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P11 – NYTO	**Knickerbocker - Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P12 – NYTO	**None**	-	-	-	-	-	-	-	-	-
P14 – NYTO	**Leeds - Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P19a – NextEra	**Greenbush - Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P20 – Boundless	**None**	-	-	-	-	-	-	-	-	-
P21 – Boundless	**None**	-	-	-	-	-	-	-	-	-

Notes:

Assumed lines to be replaced in 11 – 20 years in STARS report occur in 2030.

Assumed all identified aging facilities will require a full rebuild to calculate the avoided capital cost; used generic equipment cost of $2.6m for a 115 kV Tx rebuild to calculate avoided capital cost for 115 kV Lines.

See slides 46 – 47 for an explanation of how we convert 2015 overnight costs to PVRR in 2015$.

Contents

RPS/CO_2 Benefits of Transmission

Approach: We estimated potential cost reductions for achieving future wind capacity goals from the addition of the proposed transmission solutions

- The cost of meeting a specific MWh renewables policy goal is estimated as the additional "REC" payments required to attract new wind generation
- REC cost savings may occur due to higher LBMPs and/or reductions in curtailments
- Neither of the alternative solutions are expected to provide benefits to future renewable capacity development

Impact of transmission on wind revenues: We used findings from the 2010 Growing Wind report and the MAPS production cost analysis to estimate the impact of the proposed transmission solutions

- We assume curtailment impact is negligible since most curtailments are due to local constraints that are not resolved by the proposed solution
- Based on MAPS modeling of the proposed solutions, the LBMPs in zones in which new wind capacity is expected to be built increase by the following amounts:

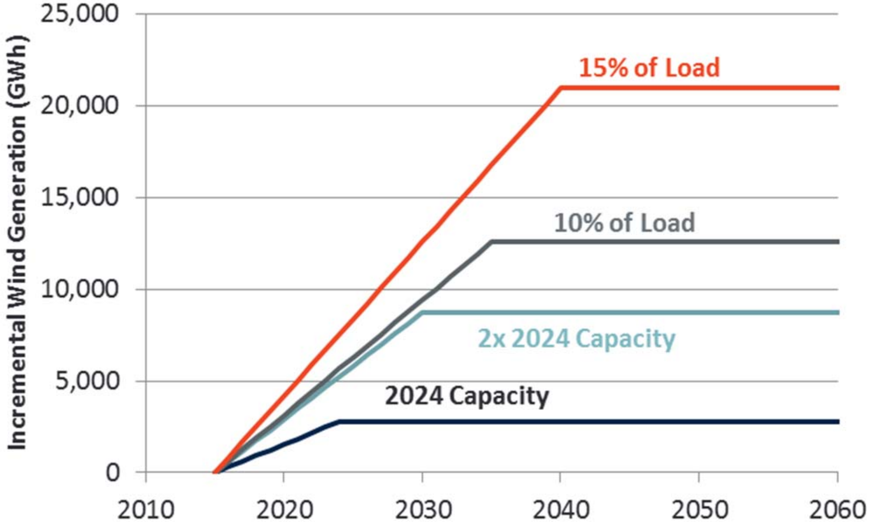
UPNY LBMP Impact of Transmission Solutions ($/MWh)

Year	P6	P7	P9	P11	P12	P14	P19a	P20	P21
2019	$0.25	$0.29	$0.40	$1.45	$1.65	$1.60	$0.25	$0.13	$0.16
2024	$0.45	$0.52	$0.69	$1.58	$1.76	$1.75	$0.45	$0.29	$0.29

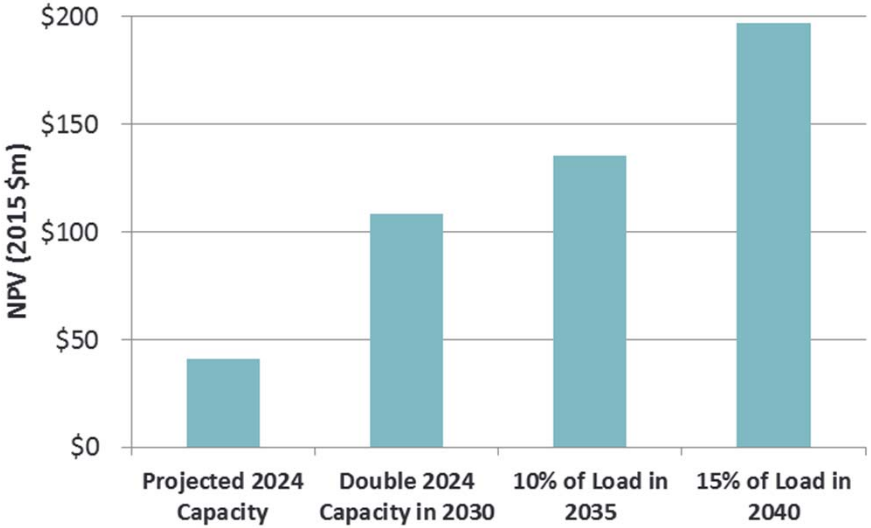
Summary of RPS/CO_2 Benefits

Depending on the assumed goals, the savings for P14 in 2024 could be \$5m to \$13m with an NPV of \$41m to \$197m in benefits with an average of \$120m

Future RPS Scenarios



NPV for P14 of Future RPS Scenarios



RPS/CO2 Benefits of Transmission Portfolios (\$m)

RPS	P6	P7	P9	P11	P12	P14	P19a	P20	P21
Low	\$10	\$11	\$15	\$37	\$41	\$41	\$10	\$6	\$6
2x 2024	**\$27**	**\$31**	**\$41**	**\$97**	**\$108**	**\$108**	**\$27**	**\$17**	**\$17**
High	\$49	\$56	\$75	\$177	\$197	\$196	\$49	\$32	\$32

Contents

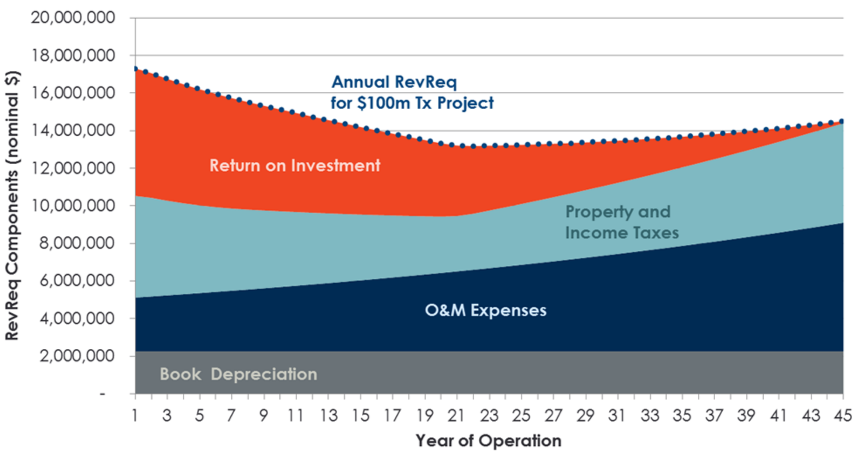
State and Local Taxes

Taxes as a cost and benefit: While property and state income taxes are a transfer between entities within NY, we include them in our analysis as a benefit to offset their inclusion in the RevReq calculation; account for 28% of PVRR

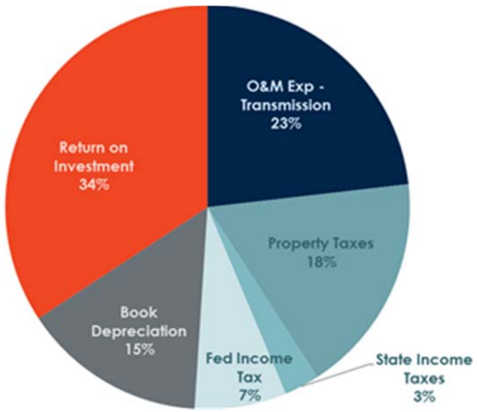
- Property tax rate of 2.18% is included in RevReq analysis for transmission and constitutes 18% of PVRR due to DPS assumption that taxes escalate at inflation over 45 year life
- Total effective income tax rate of 40% is assumed in RevReq analysis, including 7.1% state income taxes; state income taxes add 3% to PVRR
- Federal income taxes are not included in the analysis since NY ratepayers are not likely to receive a direct benefit from the amount paid; add 7% to PVRR

For ratepayer analysis, we estimated UPNY/SENY tax receipts assuming property taxes are received by proximate localities and income taxes distributed by load

Annual RevReq Components



Contribution of Components to PVRR



Accounting for Tax Payments and Receipts

In addition to taxes paid and received from proposed Tx portfolios, we also accounted for changes in taxes due to the upgrade and refurbishment of existing lines

- Existing Line Upgrades:
  - Similar to our approach for calculating avoided O&M costs of existing lines (*see slide 112*), we account for property taxes paid and received from existing lines
  - In societal analysis, we place both taxes paid and received in "Tax Receipts" category such that they cancel each other out
  - In ratepayer analysis, we include taxes no longer paid in Avoided Tx Costs and taxes no longer received separately in the taxpayer impact analysis
- Avoided Refurbishment Projects:
  - Taxes that are avoided by removing need to refurbish lines are included as a benefit with the rest of the avoided RevReq in the Avoided Tx Costs category
  - Tax that will not be received are counted as an offset to increased taxes paid by the proposed Tx portfolios in the Tax Receipts category

See examples on slide 28

Contents

Increased Employment During Construction

Investment in new transmission facilities will have employment impacts in the regions in which the facilities are built

- Based on previous analysis using NREL's JEDI model, every $1m in transmission investment results in 6.6 full-time equivalent ("FTE") jobs during construction
- 60% of jobs are directly associated with the project and the remaining 40% indirect or induced
- The capital costs of the proposed solutions range from $360 to $1,200m, which would be expected to result in 2,400 to 8,000 FTEs

This does not account for the effects of rate impacts on customer spending and associated economic activity

Also, does not include employment benefits from ongoing transmission maintenance and improved viability of upstate generators

- Near term, we project upstate generator revenues to increase by $1 – 2/kW-mo
- Long term, we project 800 – 1,000 MW of additional UPNY capacity

Increased Revenues to Upstate Generators ($/kW-mo)

Unit Type	Capacity Factor	LBMP Impact $1/MWh	LBMP Impact $2/MWh	Capacity Revenues	Total
Nuclear	95%	$0.7	$1.4	$0.5 - 1.0	$1.2 - 2.4
CC	60%	$0.4	$0.9	$0.5 - 1.0	$0.9 - 1.9
Oil/Gas Steam	40%	$0.3	$0.6	$0.5 - 1.0	$0.8 - 1.6

Contents

Transmission Value under Extreme Conditions

Transmission Value under Extremes Conditions: The additional transfer capacity provided by transmission lines can avoid or limit the effects of extreme conditions that are not to be expected (and not modeled) but are also not uncommon during short term operations and longer term

- *Extreme conditions that affect operations in the short term:*
  - Fluctuations in uncertain variables (including fuel prices, transmissions and generation availability, and load) occurring simultaneously can result in extremely high cost events that may be avoided with additional transmission;
  - Examples from NY or other markets: 2014 Polar Vortex; 2011 Feb & summer in TX
- *Extreme scenarios that can affect costs and reliability for longer periods:*
  - Changes in the availability of large transmission or generation facilities over an extended period of time (due to equipment failure or environmental restrictions) can result in sustained high costs that may be avoided with additional transmission
  - Examples from NY or other markets: the San Onofre nuclear unit shut down in CA; preparing for federal CO_2 restrictions that may limit operation hours of local resources

Source: Pfeifenberger, Chang, and Sheilendranath, Toward More Effective Transmission Planning: Addressing the Costs and Risks of an Insufficiently Flexible Electricity Grid, Prepared for WIRES, April 2015.

Expected versus Insurance Value

Value that Tx may provide by protecting against extremes can be captured both through the *expected value* of costs avoided (e.g., production costs) and the *insurance value* of limiting such costly events from occurring due to the addition of new Tx

Effects of mitigating extremes on the *expected value* of new transmission:

- Conceptually, should account for a range of conditions/scenarios weighted by probabilities
- We aimed to include the effect of extremes conditions on the expected value by multiplying our modeled PCS by the "multipliers" described on slides 84-87, but this approach may not capture all possibilities affecting the expected value
- We did not include effects of extreme scenarios on capacity costs, except as sensitivity analyses (and our IP-Out scenario was also only a sensitivity analysis)

The insurance value concept:

- Risk-averse stakeholders may be willing to pay a slight expected premium to avoid exposure to extremes
- We have not quantified the insurance value Tx provides in our analysis
- Including the insurance value in the evaluation of additional transmission capacity could in some cases result in a more "conservative" approach to planning than the more common outcome of avoiding high capital cost projects

V.H. Non-Quantified Benefits

Market Benefits and Future Capacity Options

Market Benefits: Increased competition and market liquidity can reduce costs to NY ratepayers due to more competitive bids into the energy market, reduced transaction costs, and improved information for long-term planning and investment decisions

- Although not quantified, all Tx projects increase competition and liquidity by providing additional access to trading hubs
- Additional generation capacity may increase competition depending on ownership
- Net load reductions of REV resources increase competition by reducing pivotality

Maximizing Future Capacity Options on Existing ROW: New Tx facilities can be "upsized" beyond the capacity required to meet reliability standards or make space for 2nd circuit

- Most proposals add more capacity than currently "needed" for reliability or congestion relief
- Although no proposals add space for future circuits, one proponent (NAT) requested guidance from DPS on whether to build their lines to provide the option for future double circuit capability

Resiliency and Synergies with Future Projects

Storm Hardening and Resiliency: Transmission towers and substations built with current technology and to current standards provide a more resilient system during storms

- Projects re-building (P12), replacing (P12), or re-conductoring (P9/P12/P20) existing lines will increase system resiliency due to updated construction standards
- Parallel path benefit may be limited for projects on existing ROW
- For example, Boundless notes that many existing lines do not meet current ice loading standards; new facilities will meet the standards and increase system resilience
- Generation and REV resources both provide additional local resources or reduce demand that may mitigate loss of Tx and generation facilities

Synergies with Other Future Transmission Projects: Transmission lines built to serve other needs (e.g., policy upgrades) can create low-cost options to quickly increase load-serving capability or increase access to renewables

- Tx projects extending north and west provide the most possibilities, including providing lower cost upgrades to accommodate increased industrial capacity and load growth north of Albany
- STARS and Wind Vision reports identified need for further upgrades to replace aging infrastructure and to serve additional renewable development
- Generation and REV resources may reduce the need for future transmission projects

Relieving Gas Constraints

Relieving Gas Transport Constraints: additional Tx capacity can relieve gas transport constraints by changing the location where NG is used for generation

- Few gas constraints in current system, but more Tx capacity may help in contingencies and in a future with more gas demand and changing flow patterns
- Relieving gas transport constraints could potentially reduce fuel switching from gas to oil and avoid higher production costs and higher emission from burning oil
- Generation will add local demand that may result in additional costs on a constrained system
- Reduced demand due to REV resources will help if downstate gas becomes constrained
- The combination of fewer transmission constraints and gas transport constraints will increase potential sites for developing new generators. Some of these sites may have fewer scheduling constraints for construction, providing "speediness" benefits (e.g., build a new plant upstate in 2 years vs take 3 years downstate)

Appendices

Appendix A: Analysis Without CPV Valley

A1. Solutions Analyzed

A2. Benefit-Cost Analysis Results

A3. Detailed Cost Information

A4. Detailed Benefit Analysis

A1. Solutions Analyzed
Proposed Transmission Portfolios

- Started with 21 Tx portfolios proposed by 4 developers, plus 1 add-on portfolio (P19a) requested by DPS
- For efficiency purposes, DPS selected 6 representative portfolios for detailed analysis (reps are highlighted in the table)
  - The 6 include at least one from each of 5 groups NYISO identified based on electrical similarities
  - The 6 include a project from each developer
  - The 6 are used to extrapolate benefits to the other 16

(*See appendix for acronym definitions*)

Group A	Hudson Valley reconductoring, PARs, or series comp
P7 - NYTO	LD-PV reconductor
P8 - NYTO	Hurley PARs
P13 - NYTO	Edic-NS, NS-LD reconductor, Hurley PARs
P20 - Boundless	**NS-LD SR, (LD-PV, LD-HA, CPV-RT reconductor), LD-HA-R SC, RS-EF two ca**
P21 - Boundless	P20 minus LD-PV reconductor
Group B	**Hudson Valley additional transmission**
P6 - NYTO	KN-PV
P9 - NYTO	**NS-LD reconductor, LD-PV**
P19 - NextEra	O-FR, KN-PV
P19a - NextEra	**GB-KN-CH-PV**
Group C	**Hudson Valley reconductoring plus Central East**
P12 - NYTO	**Edic-NS, NS-LD reconductor, LD-PV reconductor**
Group D	**Hudson Valley additional transmission plus Central East**
P10 - NYTO	O-FR, Edic-NS, KN-PV
P11 - NYTO	Edic-NS, KN-PV
P14 - NYTO	Edic-NS, NS-LD reconductor, LD-PV
P15 - NextEra	O-FR, Edic-LD-PV
P16 - NextEra	O-FR, Marcy-Princetown, KN-PV
P17 - NextEra	**O-FR, Marcy-Princetown-NS-KN-PV**
P18 - NextEra	O-FR, Marcy-NS, KN-PV
Group E	**Hudson Valley additional transmission plus Marcy South**
P1 - NAT	Edic-Fraser, NS-LD-PV
P2 - NAT	Edic-Fraser, NS-LD-PV Alt
P3 - NAT	Edic-Fraser, NS-LD-PV, FR-G SC, Fraser tie M-CC
P4 - NAT	**Edic-Fraser, NS-PV, FR-G SC, Fraser tie M-CC, M/E-NS SC**
P5 - NAT	Edic-Fraser, KN-PV, FR-G SC, Fraser tie M-CC, ED-Princetown-KN

A1. Solutions Analyzed

Tx Portfolios Selected for Detailed Analysis

The projects were grouped by similarity and we analyzed the benefits and costs of the 6 selected transmission portfolios as representative of the groups

Representative Projects Selected for Detailed Analysis

GROUPINGS							
A	7 NYTOs	8 NYTOs	13 NYTOs	20 Boundless	21 Boundless		
B	6 NYTOs	9 NYTOs	19 NextEra	19a * NextEra			
C	12 NYTOs						
D	10 NYTOs	11 NYTOs	14 NYTOs	15 NextEra	16 NextEra	17 NextEra	18 NextEra
E	1 NAT	2 NAT	3 NAT	4 NAT	5 NAT		

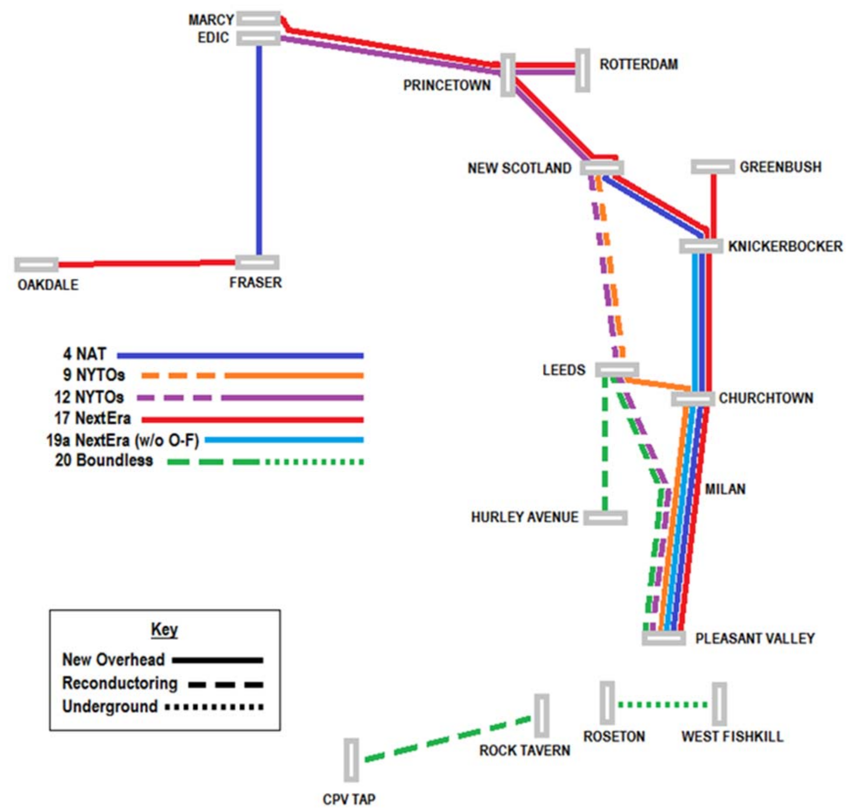
* = To be modeled without the Oakdale - Fraser Segment

Impacts on Major Interface Limits (MW)

Portfolio	SENY N-1-1	UPNY-SENY Normal N-1	UPNY-SENY Emergency N-1	Central East Voltage	Central East Limit	ISO-NE Import
P4 - NAT	1,048	933	1,203	300	420	-186
P9 - NYTO	1,198	1,351	1,598	25	292	-58
P12 - NYTO	1,228	1,200	1,200	350	617	-11
P17 - NextEra	1,123	817	1,653	350	617	-131
P19a - NextEra	1,106	679	1,528	50	317	-73
P20 - Boundless	601	588	588	-50	217	-31

Note: At request of DPS, we assume Athens SPS is removed in 2019 once the new transmission facilities are energized. While Athens SPS is in effect, Leeds-PV and Athens-PV can reach their STE ratings following the loss of a parallel circuit, assuming there is sufficient Athens generation to guarantee flows return to or below their LTE ratings within 15 minutes.

Schematic of Selected Projects



A1. Solutions Analyzed

Non-Transmission Alternatives

For a description of the Generation solution and REV resource included in this analysis, see the following slides:

- Generation: Slide 8
- REV Resources: Slide 9

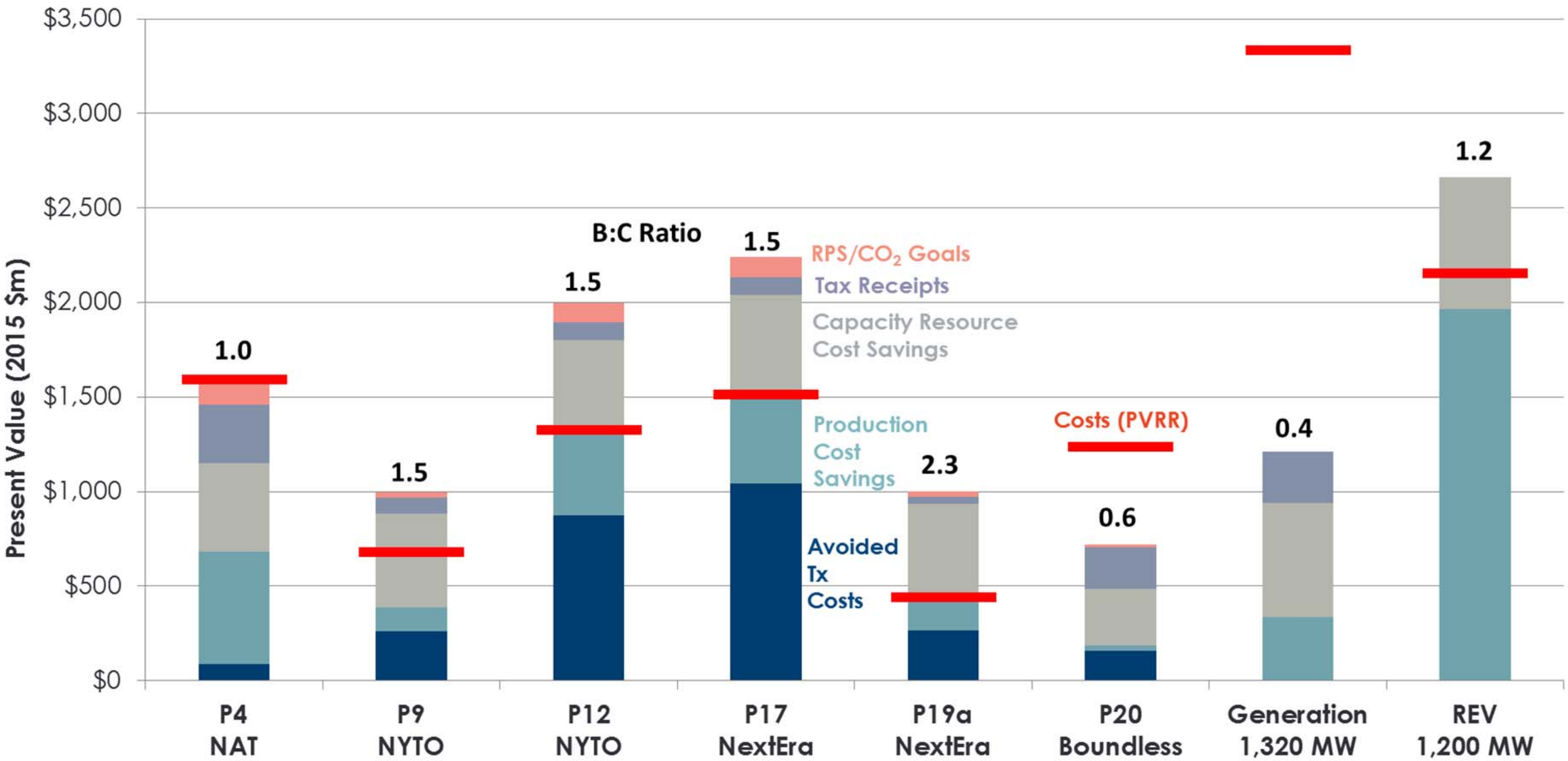
Appendix A: Analysis Without CPV Valley

Societal Benefit-Cost Analysis Results

Analysis without CPV Valley found net societal benefits for 4 Tx portfolios and the REV resources

- P19a has the highest B:C ratio of 2.3; P17 has the highest NPV of $729m
- Generation has the lowest B:C ratio of 0.4

Summary of Societal Benefit-Cost Analysis



Notes: Tx PVRRs are based on DPS's estimated 2015 capital costs, which differ from proponents' claimed costs (*see following slides*). State and local taxes shown on the benefits side cancel the non-federal taxes included in the PVRR of projects.

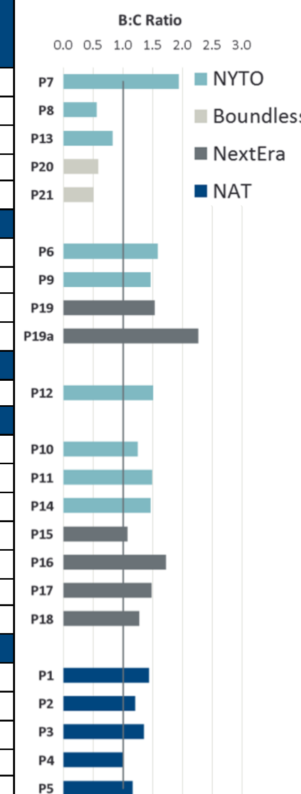
A2. Benefit-Cost Analysis Results: Societal Impacts

Benefit-Cost Analysis for All Proposed Portfolios

Analysis of all 22 portfolios identified 18 Tx portfolios with net benefits

- P19a has the highest B:C ratio of 2.3
- P16 has the highest NPV of $909m

Group A	DPS Estimated Capital Cost (2015 $m)	PVRR (2015 $m)	Production Cost Savings (2015 $m)	Capacity Resource Savings (2015 $m)	Avoided Refurb PVRR (2015 $m)	Net RPS Costs (2015 $m)	Tax Receipts (2015 $m)	Total Benefits (2015 $m)	NPV (2015 $m)	B/C Ratio
P7 - NYTO	$214	$301	$28	$423	$70	$15	$47	$583	$282	1.9
P8 - NYTO	$79	$112	$0	$39	$0	$0	$23	$62	-$49	0.6
P13 - NYTO	$676	$950	$0	$0	$748	$0	$41	$789	-$161	0.8
P20 - Boundless	**$879**	**$1,236**	**$28**	**$300**	**$157**	**$15**	**$221**	**$720**	**-$515**	**0.6**
P21 - Boundless	$632	$889	$28	$164	$76	$15	$166	$450	-$439	0.5
Group B										
P6 - NYTO	$484	$681	$178	$513	$281	$27	$82	$1,082	$401	1.6
P9 - NYTO	**$484**	**$681**	**$128**	**$494**	**$260**	**$28**	**$86**	**$996**	**$316**	**1.5**
P19 - NextEra	$498	$701	$178	$513	$264	$27	$89	$1,072	$371	1.5
P19a - NextEra	**$314**	**$441**	**$178**	**$493**	**$264**	**$27**	**$36**	**$999**	**$557**	**2.3**
Group C										
P12 - NYTO	**$943**	**$1,326**	**$460**	**$470**	**$873**	**$103**	**$93**	**$1,999**	**$672**	**1.5**
Group D										
P10 - NYTO	$1,292	$1,817	$485	$513	$998	$107	$167	$2,270	$453	1.2
P11 - NYTO	$1,042	$1,465	$485	$500	$998	$107	$95	$2,185	$721	1.5
P14 - NYTO	$1,071	$1,506	$485	$513	$995	$107	$105	$2,204	$697	1.5
P15 - NextEra	$902	$1,269	$485	$513	$0	$107	$260	$1,364	$96	1.1
P16 - NextEra	$894	$1,257	$485	$513	$1,012	$107	$50	$2,166	$909	1.7
P17 - NextEra	**$1,076**	**$1,513**	**$485**	**$513**	**$1,041**	**$107**	**$96**	**$2,242**	**$729**	**1.5**
P18 - NextEra	$861	$1,211	$485	$489	$264	$107	$194	$1,538	$328	1.3
Group E										
P1 - NAT	$711	$999	$594	$513	$0	$125	$205	$1,436	$437	1.4
P2 - NAT	$874	$1,229	$594	$513	$0	$125	$252	$1,483	$255	1.2
P3 - NAT	$765	$1,075	$594	$513	$0	$125	$220	$1,452	$377	1.4
P4 - NAT	**$1,134**	**$1,595**	**$594**	**$469**	**$87**	**$125**	**$309**	**$1,583**	**-$11**	**1.0**
P5 - NAT	$1,077	$1,515	$594	$513	$281	$125	$253	$1,765	$251	1.2

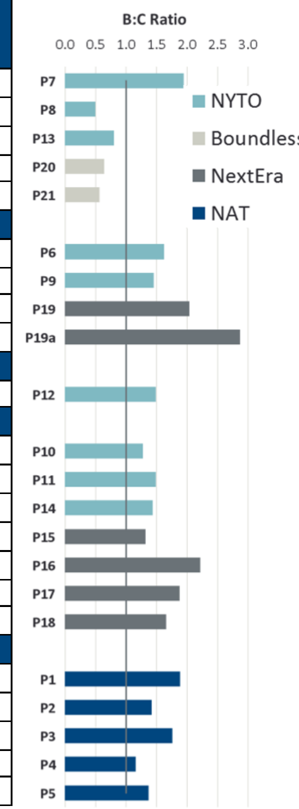


Projects in bold are the 6 selected transmission portfolios analyzed in detail as representatives of the groups

Benefit-Cost Analysis with Proponent Costs

Using the proponent's cost estimates tends to increase the NPV due to the lower estimated cost of the portfolios (*see slide 166 for a comparison of cost estimates*)

Group A	Proponent Estimated Capital Cost (2015 $m)	PVRR (2015 $m)	Production Cost Savings (2015 $m)	Capacity Resource Savings (2015 $m)	Avoided Refurb PVRR (2015 $m)	Net RPS Costs (2015 $m)	Tax Receipts (2015 $m)	Total Benefits (2015 $m)	NPV (2015 $m)	B/C Ratio
P7 - NYTO	$212	$299	$28	$423	$69	$15	$47	$582	$284	1.9
P8 - NYTO	$95	$134	$0	$39	$0	$0	$27	$67	-$67	0.5
P13 - NYTO	$701	$986	$0	$0	$746	$0	$49	$795	-$191	0.8
P20 - Boundless	**$698**	**$981**	**$28**	**$300**	**$112**	**$15**	**$178**	**$633**	**-$348**	**0.6**
P21 - Boundless	$471	$662	$28	$164	$38	$15	$128	$373	-$289	0.6
Group B										
P6 - NYTO	$470	$661	$178	$513	$279	$27	$78	$1,075	$415	1.6
P9 - NYTO	**$488**	**$686**	**$128**	**$494**	**$260**	**$28**	**$87**	**$998**	**$311**	**1.5**
P19 - NextEra	$355	$500	$178	$513	$251	$27	$51	$1,020	$520	2.0
P19a - NextEra	$239	**$336**	**$178**	**$493**	**$251**	**$27**	**$17**	**$967**	**$630**	**2.9**
Group C										
P12 - NYTO	**$958**	**$1,347**	**$460**	**$470**	**$870**	**$103**	**$97**	**$2,000**	**$654**	**1.5**
Group D										
P10 - NYTO	$1,258	$1,768	$485	$513	$998	$107	$158	$2,260	$491	1.3
P11 - NYTO	$1,047	$1,472	$485	$500	$998	$107	$97	$2,187	$714	1.5
P14 - NYTO	$1,092	$1,535	$485	$513	$991	$107	$111	$2,206	$671	1.4
P15 - NextEra	$704	$990	$485	$513	$0	$107	$203	$1,307	$317	1.3
P16 - NextEra	$671	$943	$485	$513	$996	$107	-$11	$2,090	$1,146	2.2
P17 - NextEra	**$812**	**$1,142**	**$485**	**$513**	**$1,019**	**$107**	**$25**	**$2,149**	**$1,007**	**1.9**
P18 - NextEra	$627	$881	$485	$489	$251	$107	$129	$1,460	$579	1.7
Group E										
P1 - NAT	$522	$734	$594	$513	$0	$125	$150	$1,382	$648	1.9
P2 - NAT	$718	$1,009	$594	$513	$0	$125	$207	$1,438	$429	1.4
P3 - NAT	$563	$792	$594	$513	$0	$125	$162	$1,394	$602	1.8
P4 - NAT	**$930**	**$1,308**	**$594**	**$469**	**$79**	**$125**	**$252**	**$1,518**	**$210**	**1.2**
P5 - NAT	$887	$1,246	$594	$513	$273	$125	$199	$1,704	$457	1.4

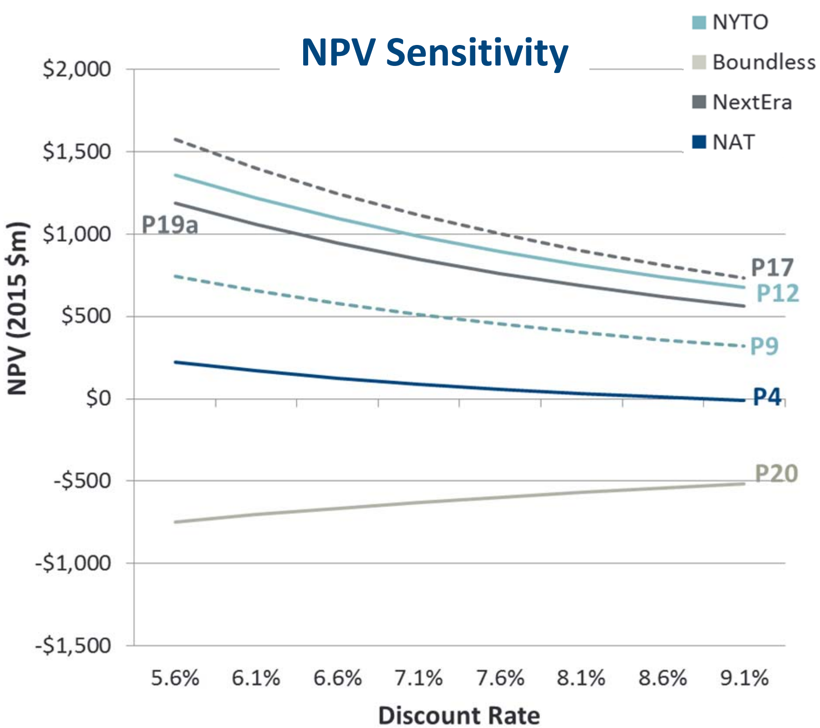


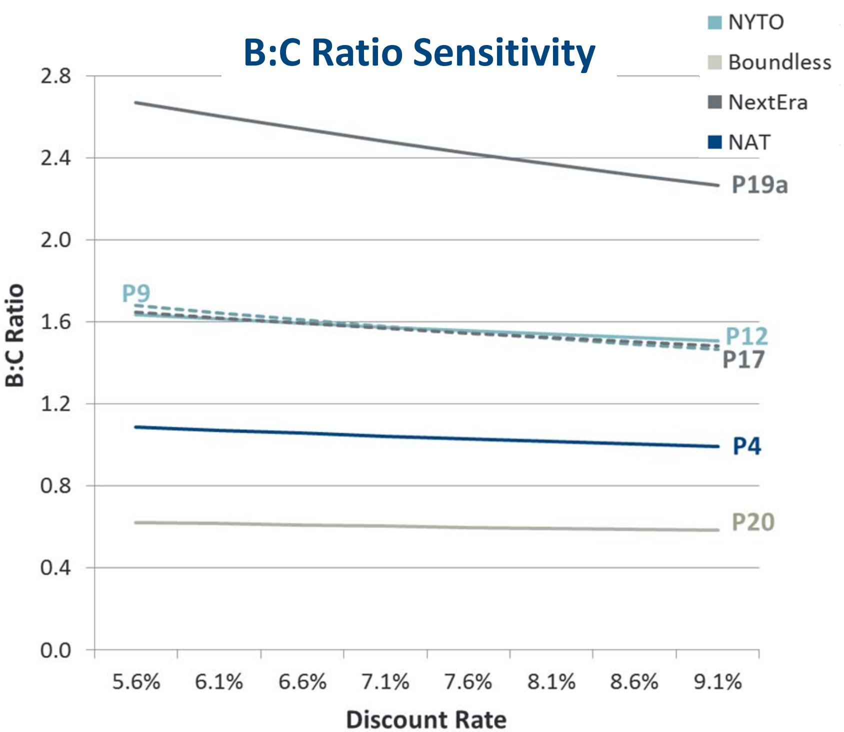
Projects in bold are the 6 selected transmission portfolios analyzed in detail as representatives of the groups

Discount Rate Sensitivity Analysis

Analyzed impact of discount rate on NPV and B:C ratio by reducing DPS recommended assumption of 9.13% at the high end to 5.6% (reflecting utility ATWACC) at the low end

- Lower discount rate increases NPV of most portfolios by $200-800m (but decreases NPV of P20 by $200m due to its benefits being small relative to its PVRR)
- Due to back-weighted benefits, lower discount rates increase B:C ratios by 0.0– 0.4



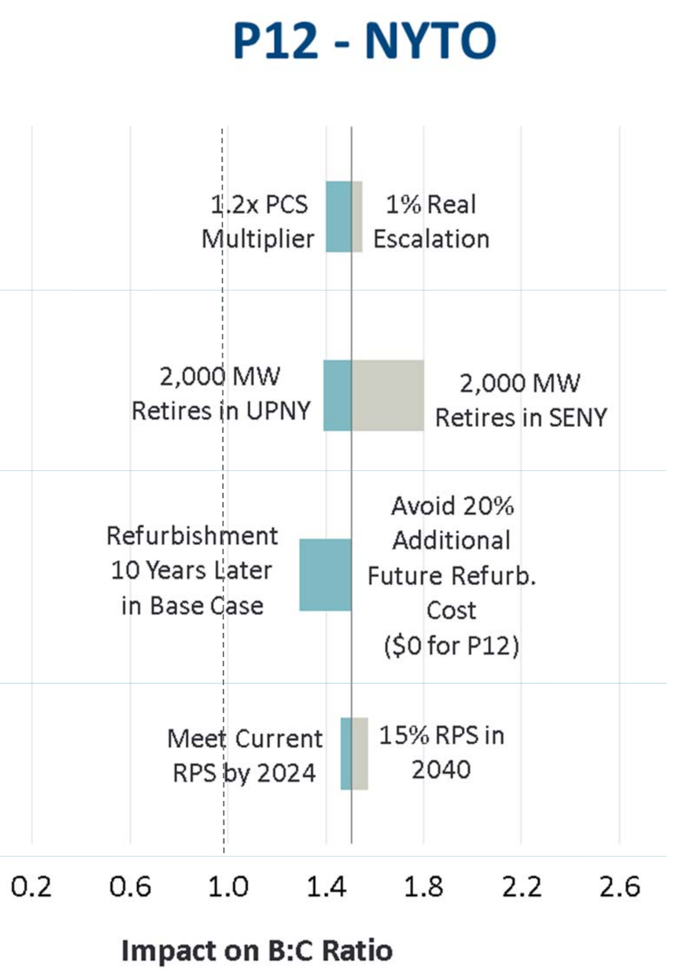


A2. Benefit-Cost Analysis Results: Societal Impacts

B:C Ratio Sensitivity Analysis of Benefit Assumptions

Sensitivity Analysis Assumptions

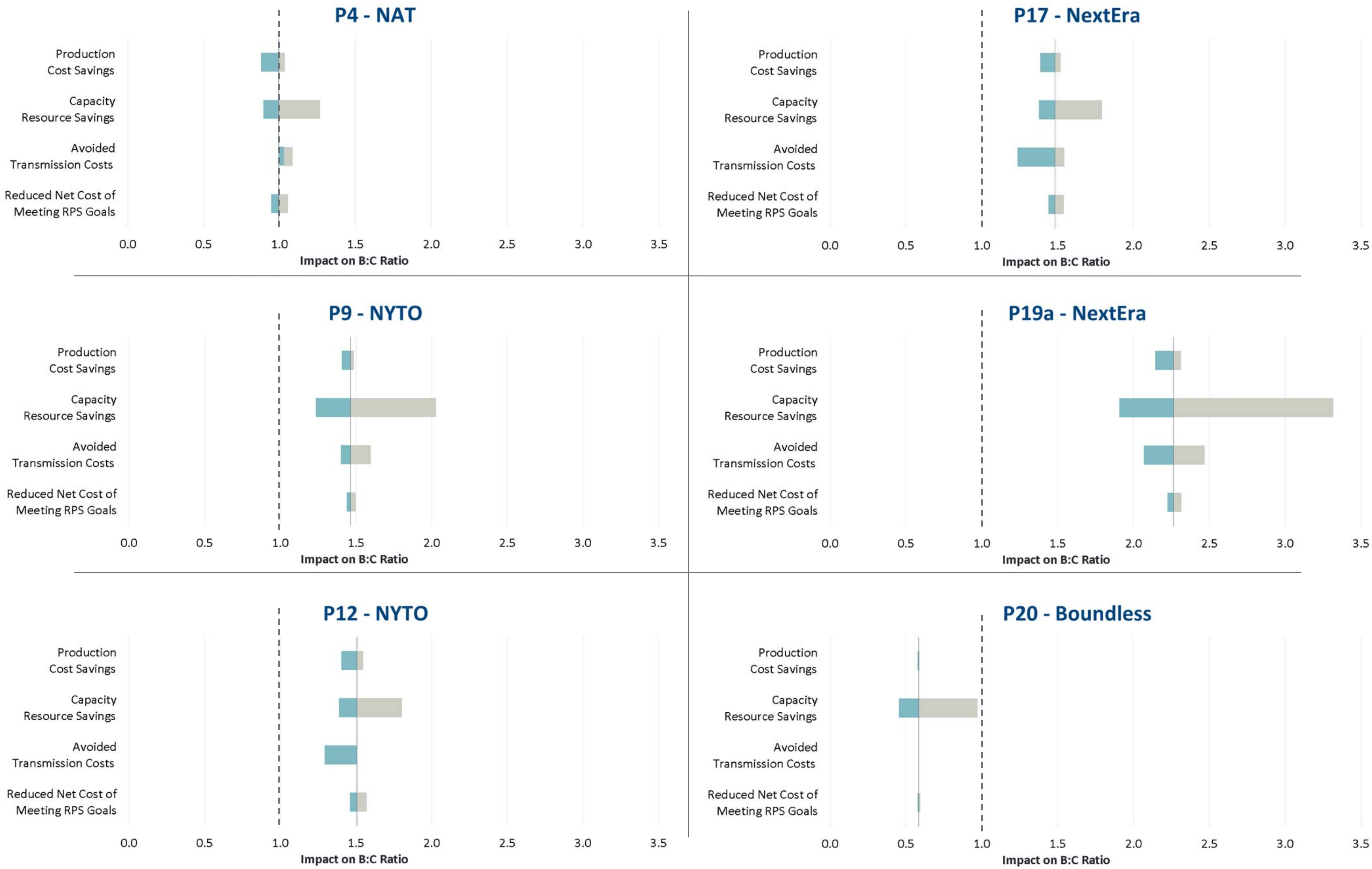
Benefit Category	Lower Value Case	Primary Assumption	Higher Value Case
Production Cost Savings (PCS)	Reduce PCS multiplier to 1.2x	Multiply MAPS PCS by 1.6 to account for factors not modeled in Base Case; escalate post-2024 PCS at inflation	Post-2024 PCS escalates at inflation + 1%
Capacity Resource Savings	2,000 MW retires in UPNY (with or w/o new Tx)	No exit of existing/planned supply, except in response to reduced LCRs	2,000 MW retires in SENY (with or w/o new Tx)
Avoided Transmission Costs	Refurbishment could be delayed 10 years	Projects that *refurbish* aging facilities get a "credit" on the latest date indicated in STARS; projects that *facilitate* future refurbishments NOT credited for reducing future construction costs	Projects that add a parallel path to aging facilities reduce future refurbishment costs 20% (by avoiding extended construction)
Reduced Net Cost of Meeting RPS Goals	Meet current RPS by 2024 and no more thereafter	RPS increases in 2030 to 2x the 2024 RPS	15% RPS in 2040



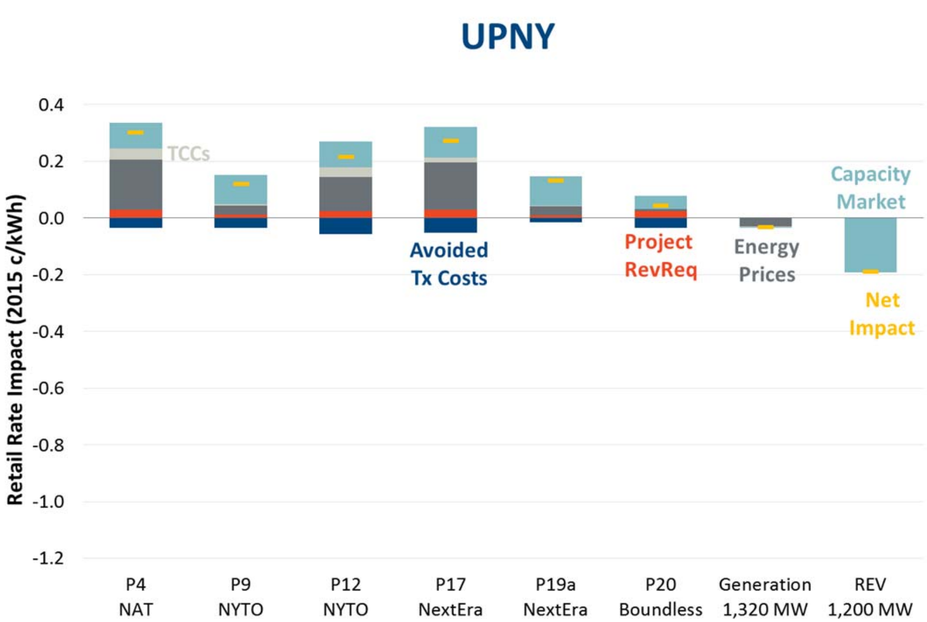
Note: These cases represent the outer envelope of a larger set of sensitivities we considered; we did not test the sensitivity to uncertainty in project cost assumptions

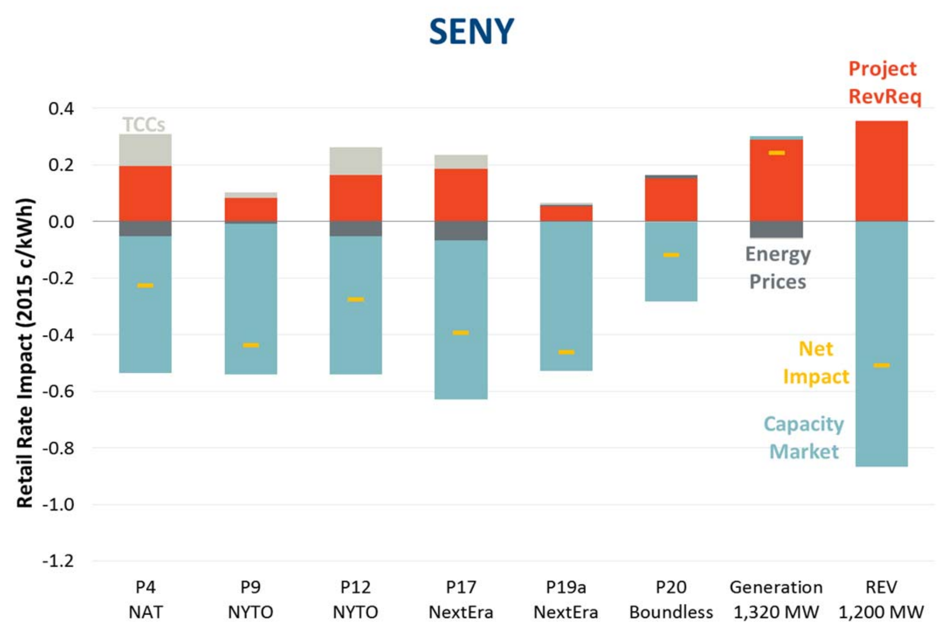
A2. Benefit-Cost Analysis Results: Societal Impacts

B:C Ratio Sensitivities Across Tx Portfolios



2019 Ratepayer Impacts





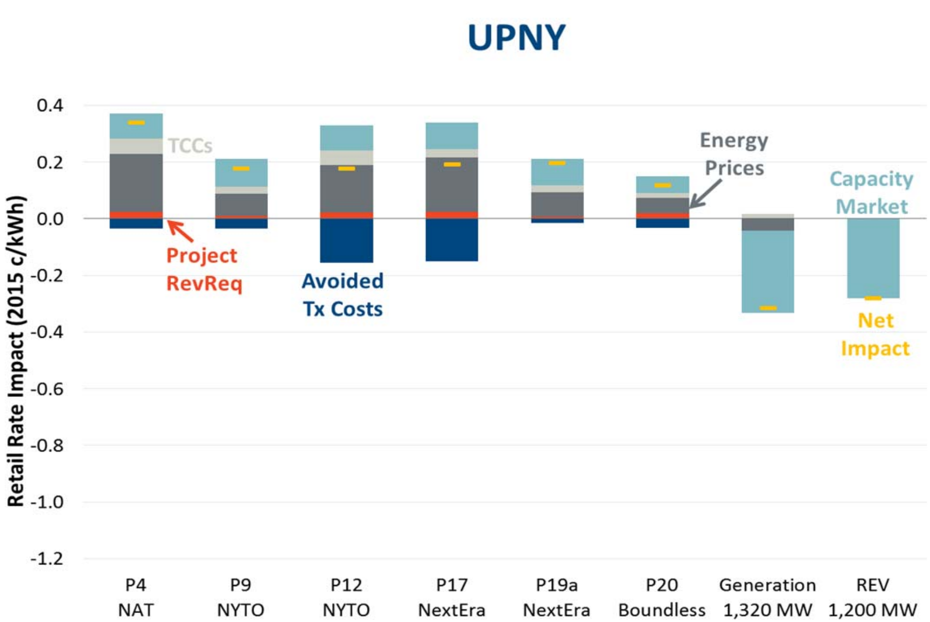
Net Tax Receipts in 2019 - UPNY

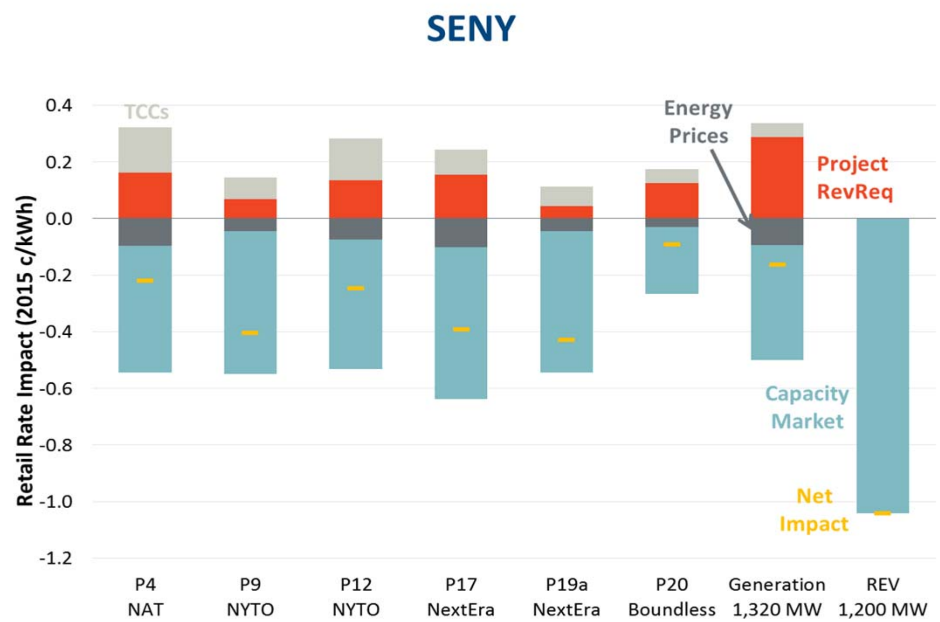
	P4	P9	P12	P17	P19a	P20	Gen	REV
$m	18	3	9	14	3	8	--	--
c/kWh	0.03	0.00	0.01	0.02	0.00	0.01	0.00	0.00

Net Tax Receipts in 2019 - SENY

	P4	P9	P12	P17	P19a	P20	Gen	REV
$m	8	3	6	6	2	11	16	
c/kWh	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00

2024 Ratepayer Impacts





Net Tax Receipts in 2024 - UPNY

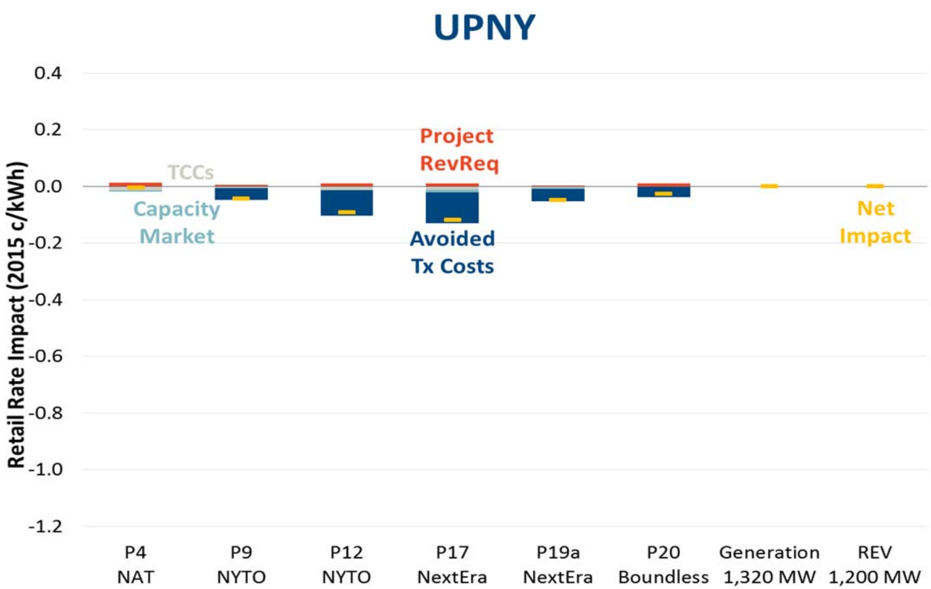
	P4	P9	P12	P17	P19a	P20	Gen	REV
$m	17	2	2	6	3	7	--	--
c/kWh	0.03	0.00	0.00	0.01	0.00	0.01	0.00	0.00

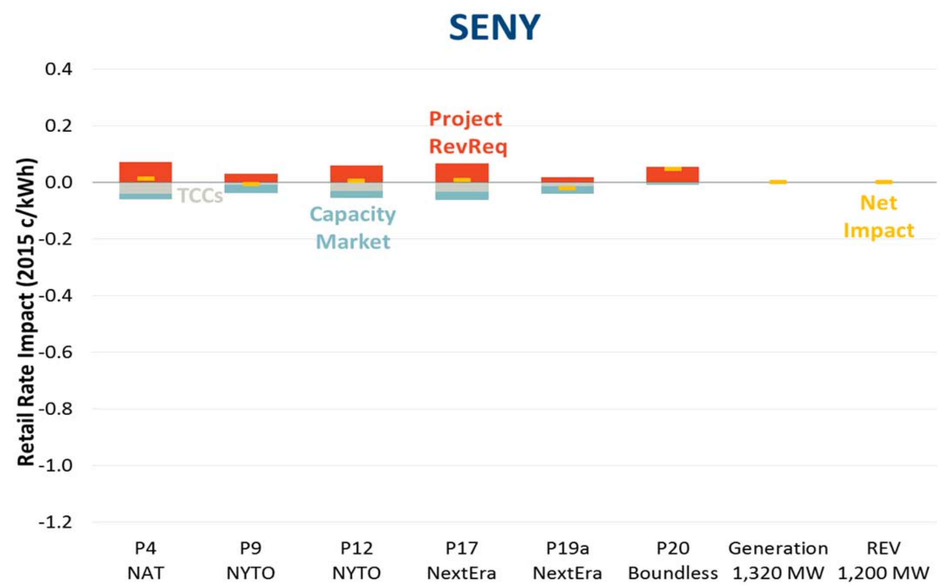
Net Tax Receipts in 2024 - SENY

	P4	P9	P12	P17	P19a	P20	Gen	REV
$m	6	2	1	2	2	9	16	--
c/kWh	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.00

Long-Term Rate Impacts

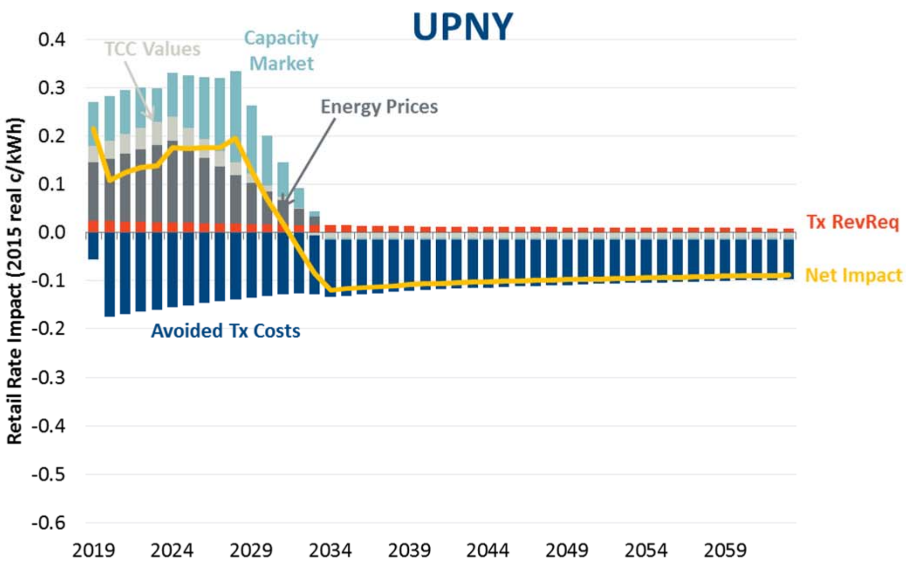
See slide 25 for a summary of the long term rate impact assumptions

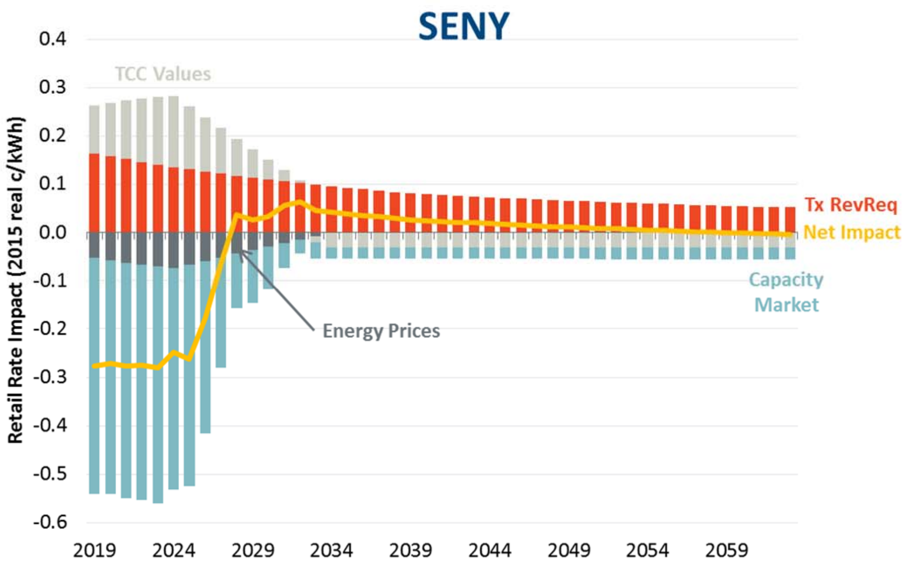




Annual Rate Impacts (P12 example)

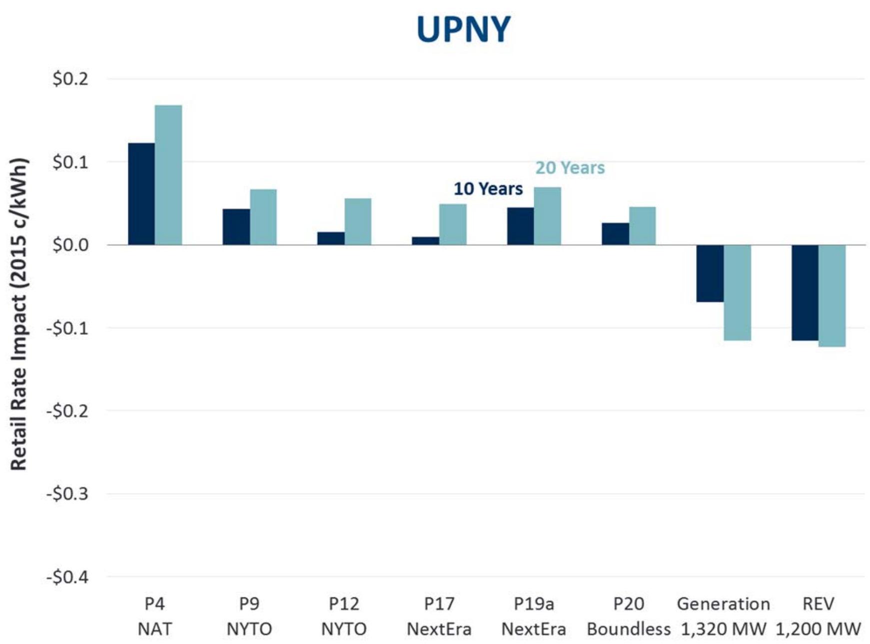
See slide 26 for a summary of the annual rate impact assumptions

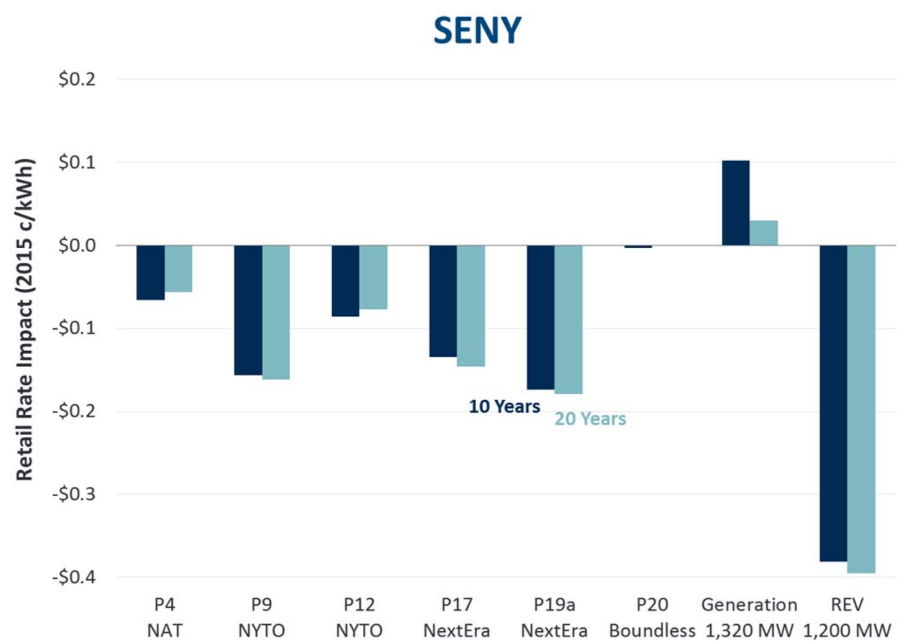




Levelized Rate Impacts

See slide 27 for a summary of the levelized rate impact calculations





IP Retirement MAPS and ICAP Impact

MAPS Results: While IP Retirement increases production costs in all cases, both Tx and Generation additions mitigate production cost increases, with greater savings associated with Tx

- NYCA Adjusted Production Costs increase by $700m in 2019 and $900m in 2024 with the retirement of Indian Point and no additional Tx or generation
- Additional generation or transmission lowers production costs compared to the IP out Base Case
- Tx solution has lower production costs than Generation by $56m in 2019, and $8m in 2024

ICAP Results: Capacity in G-J decreases, but Tx Solution increases transfers into SENY

- Capacity decreases by 2,000 MW with the retirement of IP, assuming no additional Tx or Generation
- Tx solution results in 871 MW less new capacity in G-J than in the Compensating Gen case (assuming new entry at net CONE)

Scenario	Production Costs ($m)		G-J Capacity (MW)	
	2019	2024	2019	2024
Base Case	$3,561	$4,339	15,903	16,014
IP-out Base Case (no Compensating Generation)	$4,273	$5,242	13,903	14,014
IP-Out Base Case with Compensating Generation	$4,256	$5,196	15,555	16,014
IP-Out with Tx Solution	$4,217	$5,188	14,683	15,143
IP Out Delta (Tx Solution – Generation Solution)	**($56)**	**($8)**	**-872**	**-871**

Note: Results reflect analysis of P12 in IP retirement scenario. Similar results are expected for other Tx solutions.

IP Retirement Results

Societal value of Tx portfolios increase in the Indian Point retirement scenario. Compared to the value of Tx with IP in:

- Production cost savings *decrease* by $280m (but still positive) for P12 since the no-Tx Compensating Generation alternative assumed to add new, efficient CCs in SENY (although Tx savings would be very high with IP out, absent compensating generation)
- Capacity cost savings *increase* by $120–450m in NPV (depending on the project) due to short-term need for capacity in SENY; transmission allows delay and shift to Upstate
- Net impact for P12 is an increase in NPV of $70m (increasing B:C ratio to 1.6)

A2. Benefit-Cost Analysis Results: Benefits by Project

P4 NAT (Group E)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $1134m	**PVRR = -$1595m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $34m in 2019; $42m in 2024 Multiplier for Other Factors = 1.6x	**$594m**	-$181m with lower 1.2x multiplier to +$68m with 1% real escalation
Early Refurbishment Credits	See later slides	**$87m**	+$39m if Refurbishment Required 10 Years Later in the Base Case +$112m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 867 MW in G-J, 278 MW in J, 163 MW in K Resource Cost Svgs = $25m in 2019; $40m in 2024 Variant 1 = $31m in 2019; $46m in 2024 Variant 2 = $201m in 2019; $196m in 2024	**Resource Cost Svgs = $469m** Variant 1 = $499m Variant 2 = $720m	-$157m if 2,000 MW retires in UPNY to +$438m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $1.8/MWh in 2019, $2/MWh in 2024 Saves: $4.2m in 2019; $10.7m in 2024	**$125m**	-$78m to just meet 2024 RPS to +$103m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$25m in 2019; $27m in 2024	**$309m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = -$11m** **B/C Ratio = 1**	

Annual Emissions Impacts	Total System CO_2: 0 % in 2019; 0 % in 2024 Total System NO_x: 0.02% in 2019; -0.09 % in 2024 Total System SO_2: 0.03% in 2019; -0.14 % in 2024	NYCA CO_2: -0.72 % in 2019; -1.03 % in 2024 NYCA NO_x: -0.03% in 2019; -1.35 % in 2024 NYCA SO_2: 3.66% in 2019; -5.07 % in 2024
Employment During Construction	7500 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1030 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

A2. Benefit-Cost Analysis Results: Benefits by Project

P9 NYTO (Group B)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $484m	**PVRR = -$681m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $4m in 2019; $10m in 2024 Multiplier for Other Factors = 1.6x	**$128m**	-$39m with lower 1.2x multiplier to +$16m with 1% real escalation
Early Refurbishment Credits	See later slides	**$260m**	-$45m if Refurbishment Required 10 Years Later in the Base Case +$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 1025 MW in G-J, 293 MW in J, 172 MW in K Resource Cost Svgs = $27m in 2019; $42m in 2024 Variant 1 = $35m in 2019; $50m in 2024 Variant 2 = $220m in 2019; $223m in 2024	**Resource Cost Svgs = $494m** Variant 1 = $539m Variant 2 = $897m	-$157m if 2,000 MW retires in UPNY to +$384m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $0.1/MWh in 2019, $0.5/MWh in 2024 Saves: $0.3m in 2019; $2.5m in 2024	**$28m**	-$18m to just meet 2024 RPS to +$23m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$11m in 2019; $11m in 2024	**$86m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$316m** **B/C Ratio = 1.5**	

Annual Emissions Impacts	Total System CO_2: -0.02 % in 2019; -0.01 % in 2024 Total System NO_x: -0.01% in 2019; -0.04 % in 2024 Total System SO_2: -0.09% in 2019; 0.1 % in 2024	NYCA CO_2: -0.35 % in 2019; -0.47 % in 2024 NYCA NO_x: -0.22% in 2019; -1.09 % in 2024 NYCA SO_2: 0.94% in 2019; -0.45 % in 2024
Employment During Construction	3200 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1200 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

A2. Benefit-Cost Analysis Results: Benefits by Project

P12 NYTO (Group C)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $943m	**PVRR = -$1326m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $27m in 2019; $32m in 2024 Multiplier for Other Factors = 1.6x	**$460m**	-$140m with lower 1.2x multiplier to +$53m with 1% real escalation
Early Refurbishment Credits	See later slides	**$873m**	-$286m if Refurbishment Required 10 Years Later in the Base CaseN/A
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 872 MW in G-J, 279 MW in J, 164 MW in K Resource Cost Svgs = $25m in 2019; $40m in 2024 Variant 1 = $31m in 2019; $46m in 2024 Variant 2 = $201m in 2019; $200m in 2024	**Resource Cost Svgs = $470m** Variant 1 = $501m Variant 2 = $754m	-$157m if 2,000 MW retires in UPNY to +$394m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $1.3/MWh in 2019, $1.7/MWh in 2024 Saves: $3.1m in 2019; $8.9m in 2024	**$103m**	-$64m to just meet 2024 RPS to +$85m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$21m in 2019; $22m in 2024	**$93m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$672m** **B/C Ratio = 1.5**	

Annual Emissions Impacts	Total System CO2: 0.04 % in 2019; 0 % in 2024 Total System NOx: 0.06% in 2019; 0 % in 2024 Total System SO2: -0.02% in 2019; -0.14 % in 2024	NYCA CO2: -0.3 % in 2019; -0.67 % in 2024 NYCA NOx: 0.44% in 2019; -0.81 % in 2024 NYCA SO2: 6.59% in 2019; -2.21 % in 2024
Employment During Construction	6200 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1040 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

A2. Benefit-Cost Analysis Results: Benefits by Project

P17 NextEra (Group D)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $1076m	**PVRR = -$1513m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $28m in 2019; $34m in 2024 Multiplier for Other Factors = 1.6x	**$485m**	-$148m with lower 1.2x multiplier to +$56m with 1% real escalation
Early Refurbishment Credits	See later slides	**$1041m**	-$372m if Refurbishment Required 10 Years Later in the Base Case +$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 1116 MW in G-J, 305 MW in J, 179 MW in K Resource Cost Svgs = $28m in 2019; $44m in 2024 Variant 1 = $38m in 2019; $53m in 2024 Variant 2 = $233m in 2019; $241m in 2024	**Resource Cost Svgs = $513m** Variant 1 = $566m Variant 2 = $1014m	-$159m if 2,000 MW retires in UPNY to +$469m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $1.6/MWh in 2019, $1.7/MWh in 2024 Saves: $3.6m in 2019; $9.1m in 2024	**$107m**	-$66m to just meet 2024 RPS to +$88m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$23m in 2019; $25m in 2024	**$96m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$729m** **B/C Ratio = 1.5**	

Annual Emissions Impacts	Total System CO2: -0.02 % in 2019; -0.04 % in 2024 Total System NOx: 0.03% in 2019; -0.05 % in 2024 Total System SO2: 0.06% in 2019; -0.08 % in 2024	NYCA CO2: -0.53 % in 2019; -0.81 % in 2024 NYCA NOx: 0.09% in 2019; -0.83 % in 2024 NYCA SO2: 5.78% in 2019; 0.21 % in 2024
Employment During Construction	7100 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1300 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

A2. Benefit-Cost Analysis Results: Benefits by Project

P19a NextEra (Group B)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $314m	**PVRR = -$441m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $6m in 2019; $14m in 2024 Multiplier for Other Factors = 1.6x	**$178m**	-$54m with lower 1.2x multiplier to +$22m with 1% real escalation
Early Refurbishment Credits	See later slides	**$264m**	-$86m if Refurbishment Required 10 Years Later in the Base Case +$91m if Project Avoids 20% of Future Refurbishment Cost
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 1002 MW in G-J, 292 MW in J, 171 MW in K Resource Cost Svgs = $27m in 2019; $42m in 2024 Variant 1 = $35m in 2019; $50m in 2024 Variant 2 = $219m in 2019; $221m in 2024	**Resource Cost Svgs = $493m** Variant 1 = $536m Variant 2 = $887m	-$158m if 2,000 MW retires in UPNY to +$465m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $0.1/MWh in 2019, $0.5/MWh in 2024 Saves: $0.2m in 2019; $2.5m in 2024	**$27m**	-$17m to just meet 2024 RPS to +$23m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$7m in 2019; $7m in 2024	**$36m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = +$557m** **B/C Ratio = 2.3**	

Annual Emissions Impacts	Total System CO2: 0 % in 2019; -0.04 % in 2024 Total System NOx: 0.01% in 2019; -0.16 % in 2024 Total System SO2: -0.11% in 2019; -0.36 % in 2024	NYCA CO2: -0.42 % in 2019; -0.67 % in 2024 NYCA NOx: -0.31% in 2019; -1.32 % in 2024 NYCA SO2: -0.58% in 2019; -2.7 % in 2024
Employment During Construction	2100 FTE (60% direct; 40% indirect and induced)	
Retirement Preparedness	Able to accommodate 1170 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*	

A2. Benefit-Cost Analysis Results: Benefits by Project

P20 Boundless (Group A)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $879m	**PVRR = -$1236m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $-3m in 2019; $3m in 2024 Multiplier for Other Factors = 1.6x	**$28m**	-$8m with lower 1.2x multiplier to +$5m with 1% real escalation
Early Refurbishment Credits	See later slides	**$157m**	N/A
Capacity Resource Cost Savings from reduced LCR enabling exit of existing capacity, and delay and shift of new construction	LCR Reduction: 398 MW in G-J, 178 MW in J, 104 MW in K Resource Cost Svgs = $14m in 2019; $29m in 2024 Variant 1 = $16m in 2019; $30m in 2024 Variant 2 = $116m in 2019; $94m in 2024	**Resource Cost Svgs = $300m** Variant 1 = $305m Variant 2 = $282m	-$159m if 2,000 MW retires in UPNY to +$478m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	Assuming 3,600 MW new wind by 2030 REC Cost Reduction: $-0.1/MWh in 2019, $0.3/MWh in 2024 Saves: $-0.2m in 2019; $1.5m in 2024	**$15m**	-$10m to just meet 2024 RPS to +$13m for 15% RPS in 2040
Tax Receipts from property tax and state income tax in RevReq	$19m in 2019; $21m in 2024	**$221m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = -$515m** **B/C Ratio = 0.6**	
Annual Emissions Impacts	Total System CO_2: -0.03 % in 2019; -0.05 % in 2024 Total System NO_x: -0.03% in 2019; -0.06 % in 2024 Total System SO_2: -0.06% in 2019; 0.08 % in 2024	NYCA CO_2: -0.23 % in 2019; -0.34 % in 2024 NYCA NO_x: -0.27% in 2019; -0.94 % in 2024 NYCA SO_2: 1.4% in 2019; -1.54 % in 2024	
Employment During Construction	5800 FTE (60% direct; 40% indirect and induced)		
Retirement Preparedness	Able to accommodate 500 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Insurance Against Extremes, Market Benefits, Storm Hardening and Resiliency, Maximizing Future Capacity Options on Existing ROW, Synergies w/Other Future Tx Projects, Relieving Gas Transport Constraints, Help Meet EPA Clean Power Goals *(see following slides)*		

A2. Benefit-Cost Analysis Results: Benefits by Project

1,320 MW CC in G Benefit-Cost Analysis (25-year)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $2077m	**PVRR = -$3332m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $15m in 2019; $39m in 2024 Multiplier for Other Factors = 1.2x	**$337m**	-$56m with lower 1.09x multiplier to +$25m with 1% real escalation
Early Refurbishment Credits	None	N/A	N/A
Capacity Resource Cost Savings from avoided new construction	Capacity clears auction starting in 2033 due to MOPR Resource Cost Svgs = $119m in 2033 Variant 1 = $135m in 2033 Variant 2 = $262m in 2033	**Resource Cost Svgs = $602m** Variant 1 = $681m Variant 2 = $1240m	$13m if 2,000 MW retires in UPNY to +$70m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	None	N/A	N/A
Tax Receipts from property tax and state income tax in RevReq	$17m in 2019; $19m in 2024	**$273m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = -$2121m** **B/C Ratio = 0.4**	

Annual Emissions Impacts	NYCA CO_2: 0.77 % in 2019; 2.04 % in 2024 NYCA NO_x: -3.04% in 2019; -3.3 % in 2024 NYCA SO_2: -3.96% in 2019; -0.13 % in 2024	Total System CO_2: -0.07 % in 2019; -0.09 % in 2024 Total System NO_x: -0.33% in 2019; -0.5 % in 2024 Total System SO_2: -0.36% in 2019; -0.51 % in 2024
Employment During Construction	5600 FTE (66% direct; 34% indirect and induced)	
Retirement Preparedness	Able to accommodate 1320 MW of additional SENY retirements without falling below LCR in 2019	
Other Benefits not Quantified	May provide Market Benefits and Storm Resiliency *(see following slides)*	

A2. Benefit-Cost Analysis Results: Benefits by Project

1,320 MW CC in G Benefit-Cost Analysis (45-year)

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = $2077m	**PVRR = -$3473m**	N/A
Production Cost Savings, including change in losses and factors not captured in MAPS	MAPS: $15m in 2019; $39m in 2024 Multiplier for Other Factors = 1.2x	**$401m**	-$67m with lower 1.09x multiplier to +$51m with 1% real escalation
Early Refurbishment Credits	None	N/A	N/A
Capacity Resource Cost Savings from avoided new construction	Capacity clears auction starting in 2033 due to MOPR Resource Cost Svgs = $119m in 2033 Variant 1 = $135m in 2033 Variant 2 = $262m in 2033	**Resource Cost Svgs = $880m** Variant 1 = $967m Variant 2 = $1273m	$13m if 2,000 MW retires in UPNY to +$70m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	None	N/A	N/A
Tax Receipts from property tax and state income tax in RevReq	$17m in 2019; $19m in 2024	**$307m**	N/A
Monetarily Quantified Benefit-Cost		**NPV = -$1885m** **B/C Ratio = 0.5**	
Annual Emissions Impacts	NYCA CO_2: 0.77 % in 2019; 2.04 % in 2024 NYCA NO_x: -3.04% in 2019; -3.3 % in 2024 NYCA SO_2: -3.96% in 2019; -0.13 % in 2024	Total System CO_2: -0.07 % in 2019; -0.09 % in 2024 Total System NO_x: -0.33% in 2019; -0.5 % in 2024 Total System SO_2: -0.36% in 2019; -0.51 % in 2024	
Employment During Construction	5600 FTE (66% direct; 34% indirect and induced)		
Retirement Preparedness	Able to accommodate 1320 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	May provide Market Benefits and Storm Resiliency *(see following slides)*		

Note: Although very low fixed O&M costs assumed for final 20 years, additional production cost and capacity resource cost savings increased NPV by just $235m and B:C ratio from 0.4 to 0.5

A2. Benefit-Cost Analysis Results: Benefits by Project

REV Resources Benefit-Cost Analysis

Components	Base Benefit Summary	Base Present Value	PV Sensitivity Analysis
Costs	Capital Costs = \$2629m	**PVRR = -\$2156m**	N/A
Production Cost Savings, including multiplier (model vs. futures LBMPs)	MAPS: \$210m in 2019; \$336m in 2024 Multiplier for Other Factors = 1.03x in Zones GHI, 1.06x in Zone J	**\$1965m**	-\$262m if EE capacity factor is reduced to 65% to + \$89m if based on load-weighted average LMP
Early Refurbishment Credits	None	N/A	N/A
Capacity Resource Cost Savings from avoided new construction	Resource Cost Svgs = \$62m in 2019; \$101m in 2024 Variant 1 = \$72MM in 2019; \$116MM in 2024 Variant 2 = \$476MM in 2019; \$648MM in 2024	**Resource Cost Svgs = \$696m** Variant 1 = \$773m Variant 2 = \$3420m	\$136m if 2,000 MW added in SENY to +\$393m if 2,000 MW retires in SENY (resource cost savings are less sensitive to capacity additions and supply slopes)
Reduced Net Cost of Meeting RPS Goals from lower REC prices	None	N/A	N/A
Tax Receipts from property tax and state income tax in RevReq	None	N/A	N/A
Monetarily Quantified Benefit-Cost		**NPV = +\$504m** **B/C Ratio = 1.2**	
Annual Emissions Impacts	NYCA CO2: -1,231 thousand tons in 2019; -1,538 thousand tons in 2024 NYCA NOx: -1,438 tons in 2019; - 1,797 tons in 2024 NYCA SO2: -1,725 tons in 2019; -2,157 tons in 2024		
Employment During Construction	2000 to 16000 FTE (4% to 80% direct, depending on type of measure)		
Retirement Preparedness	Able to accommodate 1200 MW of additional SENY retirements without falling below LCR in 2019		
Other Benefits not Quantified	Market Benefits, Storm Resiliency, Relieving Gas Transport Constraints *(see following slides)*		

Note: Emissions reductions based on REV GEIS.

Appendix A: Analysis Without CPV Valley

A1. Solutions Analyzed

A2. Benefit-Cost Analysis Results

A3. Detailed Cost Information

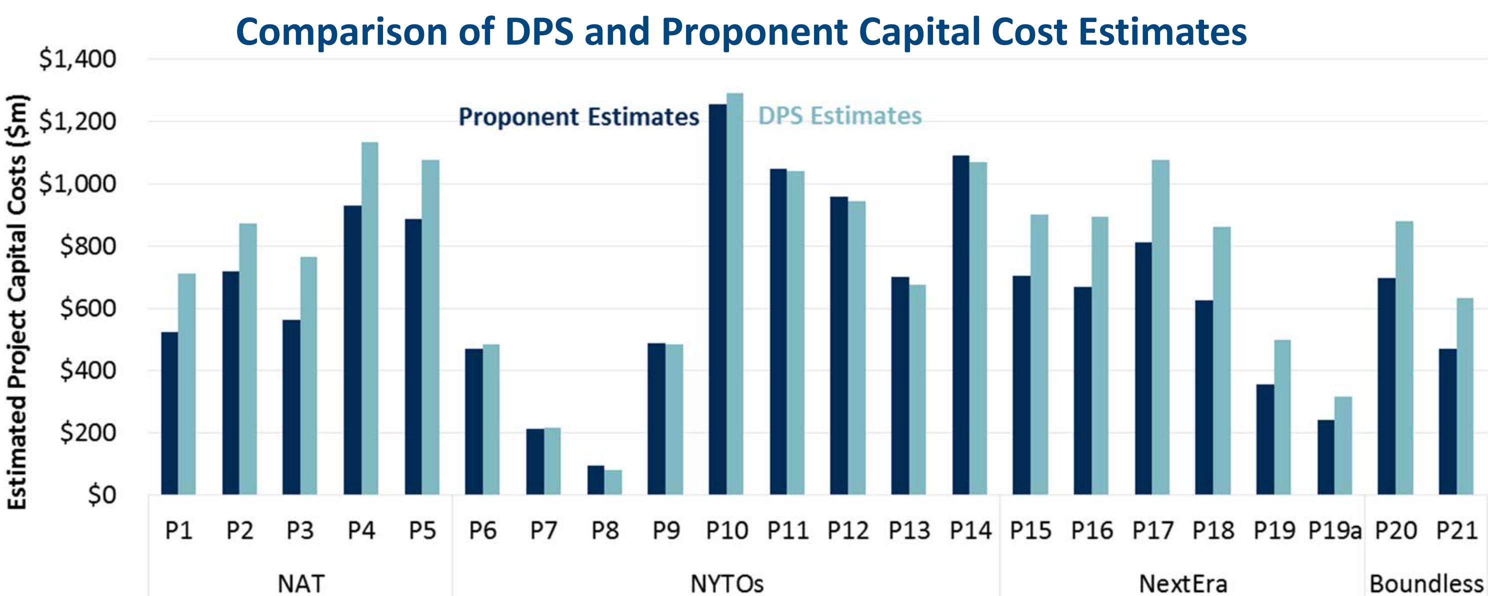
A4. Detailed Benefit Analysis

A3. Detailed Cost Analysis: Transmission

Estimated Overnight Capital Costs

DPS staff developed capital cost estimates for each Tx portfolio based on their own analysis

- We calculated NPV and B:C ratio using both cost estimates on slides 144 and 145
- All other analyses in this report use DPS's estimates



DPS Cost Estimates and PVRR for All Portfolios

Calculated the present value of the revenue requirements (PVRR) based on approach described on slides 46-47

Group A	DPS Estimated Capital Cost (2015 $m)	PVRR (2015 $m)
P7 - NYTO	$214	$301
P8 - NYTO	$79	$112
P13 - NYTO	$676	$950
P20 - Boundless	**$879**	**$1,236**
P21 - Boundless	$632	$889
Group B		
P6 - NYTO	$484	$681
P9 - NYTO	**$484**	**$681**
P19 - NextEra	$498	$701
P19a - NextEra	**$314**	**$441**
Group C		
P12 - NYTO	**$943**	**$1,326**
Group D		
P10 - NYTO	$1,292	$1,817
P11 - NYTO	$1,042	$1,465
P14 - NYTO	$1,071	$1,506
P15 - NextEra	$902	$1,269
P16 - NextEra	$894	$1,257
P17 - NextEra	**$1,076**	**$1,513**
P18 - NextEra	$861	$1,211
Group E		
P1 - NAT	$711	$999
P2 - NAT	$874	$1,229
P3 - NAT	$765	$1,075
P4 - NAT	**$1,134**	**$1,595**
P5 - NAT	$1,077	$1,515

Projects in bold are the 6 selected transmission portfolios that benefits were analyzed in detail as representative of the groups

Non-Transmission Alternatives

For a description of the cost analysis for the Generation solution and REV resources, see the following slides:

- Generation: Slide 49
- REV Resources: Slide 50

Appendix A: Analysis Without CPV Valley

A1. Solutions Analyzed

A2. Benefit-Cost Analysis Results

A3. Detailed Cost Information

A4. Detailed Benefit Analysis

MAPS Analysis without CPV Valley

The following MAPS results do not include CPV Valley. These results were analyzed in May 2015.=

- At that time, we evaluated P4 NAT, P9 NYTO, P12 NYTO, P17 NextEra, P19a NextEra, P20 Boundless, and 1,320 MW Generation (Note: Cases highlighted red were only analyzed for the without CPV Valley analysis)
- All other analyses provided above in this slide deck are including CPV Valley. These results are included for reference

For a summary of the assumptions and Base Case results of the MAPS analysis, see slides 54– 60

A4. Detailed Benefit Analysis: MAPS Analysis

P4 NAT (Group E)

Input Changes:

- Topology: new line from Edic to Fraser, NS-PV, FR-G SC, Fraser tie M-CC, M/ED-NS SC
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW with early SPS retirement
- Ratings increases on other lines binding in Base Case: nothing else significant
- Central East limits: increase by 300 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
FRASR345 345.00-GILB 345 345.00	E	F	0	16,058	0	7,614
DUNWOODIE SHORE ROAD	I	K	25,050	1,659	29,549	3,056
COOPC345 345.00-MARCCSC2 345.00	E	G	N/A	1,609	N/A	7,843
COOPC345 345.00-FRASR345 345.00	E	E	1,228	991	432	3,518
CLAY 345.00-CLAY 115.00	C	C	71	(71)	3,149	(2,999)
HUNTLEY PACKARD	A	A	49,083	(1,016)	75,491	(10,340)
GARDV230 230.00-STOLE230 230.00	A	A	5,614	(1,829)	30,592	(5,182)
VOLNEY SCRIBA	C	C	29,874	(20,003)	46,059	(32,699)
LEEDS PLEASANT VALLEY	F	G	23,587	(23,587)	59,538	(59,493)
CENTRAL EAST	D/E/F	NE/F	306,077	(76,008)	295,372	(64,114)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,371,739**	**(147,902)**	**1,968,251**	**(206,608)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.97	1.26	52.03	1.17
GENESSEE (B)	35.82	1.61	47.59	1.96
CENTRAL (C)	36.78	1.46	48.85	1.60
NORTH (D)	34.34	2.19	46.15	2.44
MOHAWKVA (E)	36.49	1.72	48.50	1.95
CAPITAL (F)	47.00	(1.16)	58.37	(0.51)
HUDSONVA (G)	44.60	(0.38)	57.12	(0.48)
MILLWOOD (H)	45.00	(0.53)	57.70	(0.81)
DUNWOODI (I)	44.93	(0.49)	57.67	(0.78)
NYCITY (J)	45.45	(0.39)	58.13	(0.69)
LONGISLA (K)	48.81	(0.21)	62.27	(0.31)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,561	(34)	4,339	(42)
Total System	29,763	(34)	41,091	(41)

Source: The Brattle Group analysis using MAPS

A4. Detailed Benefit Analysis: MAPS Analysis
P9 NYTO (Group B)

Input Changes:

- Topology: add a third path from Leeds to PV, NS-Leeds reconductor
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW with early SPS retirement
- Ratings increases on other lines binding in Base Case: LEEDS3_N.SCOT99_345 increases 616 MW
- Central East limits: increase by 25 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
CENTRAL EAST	D/E/F	NE/F	306,077	9,107	295,372	5,689
COOPC345 345.00-FRASR345 345.00	E	E	1,228	1,490	432	7,385
DUNWOODIE SHORE ROAD	I	K	25,050	848	29,549	2,123
HUNTLEY PACKARD	A	A	49,083	27	75,491	(9,055)
COOPC345 345.00-MARCCSC2 345.00	E	G	N/A	5	N/A	1,542
CLAY 345.00-CLAY 115.00	C	C	71	(26)	3,149	(2,622)
GARDV230 230.00-STOLE230 230.00	A	A	5,614	(256)	30,592	(1,107)
NEW SCOTLAND LEEDS	F	F	2,185	(2,185)	7,633	(7,633)
VOLNEY SCRIBA	C	C	29,874	(5,343)	46,059	(15,013)
LEEDS PLEASANT VALLEY	F	G	23,587	(23,587)	59,538	(59,538)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,371,739**	**(24,258)**	**1,968,251**	**(92,895)**

Impacts on Zonal LBMPs ($/MWh)

Area	2019 Base	2019 Impact	2024 Base	2024 Impact
WEST (A)	37.97	0.13	52.03	0.27
GENESSEE (B)	35.82	0.15	47.59	0.62
CENTRAL (C)	36.78	0.13	48.85	0.41
NORTH (D)	34.34	0.13	46.15	0.57
MOHAWKVA (E)	36.49	0.14	48.50	0.51
CAPITAL (F)	47.00	0.38	58.37	0.79
HUDSONVA (G)	44.60	(0.02)	57.12	(0.09)
MILLWOOD (H)	45.00	(0.10)	57.70	(0.34)
DUNWOODI (I)	44.93	(0.08)	57.67	(0.32)
NYCITY (J)	45.45	(0.04)	58.13	(0.27)
LONGISLA (K)	48.81	0.04	62.27	(0.03)

Impacts on Production Costs ($m)

	2019 Base	2019 Impact	2024 Base	2024 Impact
NYCA+Imports-Exports	3,561	(4)	4,339	(10)
Total System	29,763	2	41,091	(7)

Source: The Brattle Group analysis using MAPS

A4. Detailed Benefit Analysis: MAPS Analysis
P12 NYTO (Group C)

Input Changes

- Topology: new line from Edic to New Scotland; reconductor NS-Leeds-PV
- Leeds-PV limit on existing line : pre-2024 limit increased by 523 MW with Leeds-PV reconductor
- Rating increases on other lines binding in Base Case: LEEDS3_N.SCOT99_345 increases 616 MW
- Central East limits: increase by 350 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
COOPC345 345.00-FRASR345 345.00	E	E	1,228	5,488	432	9,988
DUNWOODIE SHORE ROAD	I	K	25,050	1,988	29,549	2,590
COOPC345 345.00-MARCCSC2 345.00	E	G	N/A	15	N/A	1,656
CLAY 345.00-CLAY 115.00	C	C	71	(71)	3,149	(3,146)
HUNTLEY PACKARD	A	A	49,083	(314)	75,491	(9,059)
GARDV230 230.00-STOLE230 230.00	A	A	5,614	(1,794)	30,592	(5,756)
NEW SCOTLAND LEEDS	F	F	2,185	(2,185)	7,633	(7,633)
VOLNEY SCRIBA	C	C	29,874	(16,106)	46,059	(25,037)
LEEDS PLEASANT VALLEY	F	G	23,587	(23,587)	59,538	(59,538)
CENTRAL EAST	D/E/F	NE/F	306,077	(53,169)	295,372	(55,477)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,371,739**	**(116,286)**	**1,968,251**	**(174,815)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.97	1.08	52.03	1.18
GENESSEE (B)	35.82	1.28	47.59	1.83
CENTRAL (C)	36.78	1.22	48.85	1.55
NORTH (D)	34.34	1.65	46.15	2.13
MOHAWKVA (E)	36.49	1.41	48.50	1.83
CAPITAL (F)	47.00	(1.40)	58.37	(0.84)
HUDSONVA (G)	44.60	(0.33)	57.12	(0.27)
MILLWOOD (H)	45.00	(0.43)	57.70	(0.53)
DUNWOODI (I)	44.93	(0.41)	57.67	(0.52)
NYCITY (J)	45.45	(0.36)	58.13	(0.46)
LONGISLA (K)	48.81	(0.12)	62.27	(0.15)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,561	(27)	4,339	(32)
Total System	29,763	(16)	41,091	(29)

Source: The Brattle Group analysis using MAPS

P17 NextEra (Group D)

Input Changes

- Topology: new line from Oakdale to Fraser, Marcy-Princetown-NS-KN-PV
- Leeds-PV limit on existing line : pre-2024 limit tightened by 93 MW with early SPS retirement
- Rating increases on other lines binding in Base Case: nothing else significant
- Central East limits: increase by 350 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
VOLNEY SCRIBA	C	C	29,874	25,657	46,059	20,630
COOPC345 345.00-FRASR345 345.00	E	E	N/A	6,146	N/A	12,547
KNICKERB 345.00-N.SCOT77 345.00	F	F	N/A	3,323	N/A	4,177
DUNWOODIE SHORE ROAD	I	K	25,050	2,077	29,549	3,619
HUNTLEY PACKARD	A	A	49,083	1,049	75,491	(6,224)
CLAY 345.00-CLAY 115.00	C	C	71	(71)	3,149	(2,922)
GARDV230 230.00-STOLE230 230.00	A	A	5,614	(1,723)	30,592	(6,057)
NEW SCOTLAND LEEDS	F	F	2,185	(2,185)	7,633	(7,633)
LEEDS PLEASANT VALLEY	F	G	23,587	(23,543)	59,538	(59,432)
CENTRAL EAST	D/E/F	NE/F	306,077	(58,729)	295,372	(55,606)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,371,739**	**(94,299)**	**1,968,251**	**(127,999)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.97	1.31	52.03	1.18
GENESSEE (B)	35.82	1.47	47.59	1.79
CENTRAL (C)	36.78	1.64	48.85	1.78
NORTH (D)	34.34	1.76	46.15	2.08
MOHAWKVA (E)	36.49	1.62	48.50	1.88
CAPITAL (F)	47.00	(1.42)	58.37	(0.81)
HUDSONVA (G)	44.60	(0.52)	57.12	(0.58)
MILLWOOD (H)	45.00	(0.63)	57.70	(0.88)
DUNWOODI (I)	44.93	(0.59)	57.67	(0.84)
NYCITY (J)	45.45	(0.48)	58.13	(0.72)
LONGISLA (K)	48.81	(0.26)	62.27	(0.30)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,561	(28)	4,339	(34)
Total System	29,763	(29)	41,091	(35)

Source: The Brattle Group analysis using MAPS

A4. Detailed Benefit Analysis: MAPS Analysis

P19a NextEra (Group B)

Input Changes

- Topology: add new lines from Knickerbocker to Pleasant Valley
- Leeds-PV limit on existing line: pre-2024 limit tightened by 93 MW with early SPS retirement
- Ratings increases on other lines binding in Base Case: nothing else significant
- Central East limits: increase by 50 MW

Impacts on Zonal LBMPs ($/MWh)

Area	2019 Base	2019 Impact	2024 Base	2024 Impact
WEST (A)	37.97	0.10	52.03	0.28
GENESSEE (B)	35.82	0.09	47.59	0.60
CENTRAL (C)	36.78	0.09	48.85	0.42
NORTH (D)	34.34	0.08	46.15	0.59
MOHAWKVA (E)	36.49	0.10	48.50	0.52
CAPITAL (F)	47.00	0.42	58.37	0.83
HUDSONVA (G)	44.60	0.05	57.12	(0.08)
MILLWOOD (H)	45.00	(0.02)	57.70	(0.34)
DUNWOODI (I)	44.93	(0.00)	57.67	(0.33)
NYCITY (J)	45.45	0.02	58.13	(0.27)
LONGISLA (K)	48.81	0.02	62.27	(0.09)

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
CENTRAL EAST	D/E/F	NE/F	306,077	15,829	295,372	9,003
KNICKERB 345.00-N.SCOT77 345.00	F	F	N/A	1,147	N/A	2,042
HUNTLEY PACKARD	A	A	49,083	569	75,491	(7,041)
DUNWOODIE SHORE ROAD	I	K	25,050	161	29,549	1,610
CLAY 345.00-CLAY 115.00	C	C	71	(32)	3,149	(2,747)
GARDV230 230.00-STOLE230 230.00	A	A	5,614	(189)	30,592	(1,418)
COOPC345 345.00-FRASR345 345.00	E	E	1,228	(566)	432	3,024
NEW SCOTLAND LEEDS	F	F	2,185	(2,185)	7,633	(7,633)
VOLNEY SCRIBA	C	C	29,874	(6,827)	46,059	(15,901)
LEEDS PLEASANT VALLEY	F	G	23,587	(23,165)	59,538	(57,459)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,371,739**	**(14,734)**	**1,968,251**	**(96,499)**

Impacts on Production Costs ($m)

	2019 Base	2019 Impact	2024 Base	2024 Impact
NYCA+Imports-Exports	3,561	(6)	4,339	(14)
Total System	29,763	(12)	41,091	(16)

Source: The Brattle Group analysis using MAPS

A4. Detailed Benefit Analysis: MAPS Analysis

P20 Boundless (Group A)

Input Changes

- Topology: NS-LD SR, (LD-PV, LD-HA, CPV-RT reconductor), LD-HA-R SC, RS-EF two cables
- Leeds-PV limit on existing line: pre-2024 limit increased by 551 MW with Leeds-PV reconductor
- Ratings increases on other lines binding in Base Case: nothing else significant
- Central East limits: *decrease* by 50 MW

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
CENTRAL EAST	D/E/F	NE/F	306,077	14,211	295,372	6,698
HURLEYSC 345.00-ROSETON 345.00	G	G	N/A	12,143	N/A	23,832
VOLNEY SCRIBA	C	C	29,874	1,056	46,059	(7,790)
DUNWOODIE SHORE ROAD	I	K	25,050	553	29,549	1,614
Ramapo PAR	G	G	18,322	540	9,733	338
CLAY 345.00-CLAY 115.00	C	C	71	(29)	3,149	(2,737)
GOWANUS 345 GOETHSLN 345 1	J	J	1,056	(470)	927	(807)
HUNTLEY PACKARD	A	A	49,083	(602)	75,491	(4,908)
COOPC345 345.00-FRASR345 345.00	E	E	1,228	(1,025)	432	417
LEEDS PLEASANT VALLEY	F	G	23,587	(23,587)	59,538	(59,538)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,371,739**	**(3,670)**	**1,968,251**	**(58,927)**

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.97	(0.07)	52.03	0.21
GENESSEE (B)	35.82	(0.06)	47.59	0.36
CENTRAL (C)	36.78	(0.05)	48.85	0.22
NORTH (D)	34.34	(0.13)	46.15	0.32
MOHAWKVA (E)	36.49	(0.06)	48.50	0.30
CAPITAL (F)	47.00	0.62	58.37	0.83
HUDSONVA (G)	44.60	0.12	57.12	(0.02)
MILLWOOD (H)	45.00	0.03	57.70	(0.24)
DUNWOODI (I)	44.93	0.03	57.67	(0.23)
NYCITY (J)	45.45	0.04	58.13	(0.20)
LONGISLA (K)	48.81	0.10	62.27	(0.01)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,561	3	4,339	(3)
Total System	29,763	8	41,091	(5)

Source: The Brattle Group analysis using MAPS

P20 Boundless and Central East

Impact on Central East Limits

- In 2019, production costs increase since it is the only Tx portfolio with Central-East limits decreasing (by 50 MW)
  - Traps upstate generation and therefore leads to lower upstate LBMPs
  - Benefits of UPNY-SENY limit increase cannot be fully utilized; Leeds – PV average flow drops from 1,050 MW in the Base Case to 890 MW in the P20 Change Case
- In 2024, production costs decrease as load growth reduces surplus of lower cost generation available in UPNY
  - Therefore flow on Central East is reduced and binds less (compared to 2019)
  - The benefits of UPNY-SENY limit increase appear (indicated by lower downstate LBMP and higher upstate LBMP)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,561	3	4,339	(3)
Total System	29,763	8	41,091	(5)

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.97	(0.07)	52.03	0.21
GENESSEE (B)	35.82	(0.06)	47.59	0.36
CENTRAL (C)	36.78	(0.05)	48.85	0.22
NORTH (D)	34.34	(0.13)	46.15	0.32
MOHAWKVA (E)	36.49	(0.06)	48.50	0.30
CAPITAL (F)	47.00	0.62	58.37	0.83
HUDSONVA (G)	44.60	0.12	57.12	(0.02)
MILLWOOD (H)	45.00	0.03	57.70	(0.24)
DUNWOODI (I)	44.93	0.03	57.67	(0.23)
NYCITY (J)	45.45	0.04	58.13	(0.20)
LONGISLA (K)	48.81	0.10	62.27	(0.01)

Source: The Brattle Group analysis using MAPS

A4. Detailed Benefit Analysis: MAPS Analysis

1,320 MW CC in Zone G

Input Changes

- Addition of four 330 MW CC units in Zone G for a total of 1,320 MW of added capacity
- All new units are distributed among high load buses in Zone G
- New CCs have 7,000 Btu/kWh full load heat rate and $7.01/MWh VOM (2019$), comparable to other new CCs modeled in MAPS

Impacts on Congestion Rents (10 Largest Deltas in NYISO , in $k)

Constraints	From	To	2019 Base	2019 Impact	2024 Base	2024 Impact
VOLNEY SCRIBA	C	C	29,874	15,486	46,059	26,322
DUNWOODIE SHORE ROAD	I	K	25,050	2,464	29,549	3,620
MOTTHAVEN RAINEY	J	J	1,555	1,392	171	457
GARDV230 230.00-STOLE230 230.00	A	A	5,614	296	30,592	2,267
Ramapo PAR	G	G	18,322	85	9,733	3,094
HUNTLEY PACKARD	A	A	49,083	(145)	75,491	(3,861)
NEW SCOTLAND LEEDS	F	F	2,185	(327)	7,633	(2,428)
COOPC345 345.00-FRASR345 345.00	E	E	1,228	(1,148)	432	(316)
CENTRAL EAST	D/E/F	NE/F	306,077	(1,538)	295,372	1,427
LEEDS PLEASANT VALLEY	F	G	23,587	(7,669)	59,538	(15,287)
Total Congestion Rents (NYISO, PJM, ISO-NE, Ont)			**1,371,739**	**13,767**	**1,968,251**	**13,891**

New Unit Capacity Factors

Unit	2019 Capacity	2024 Capacity
Generic CARIS Add CC1 Zone G	39%	42%
Generic CARIS Add CC2 Zone G	36%	39%
Generic CARIS Add CC3 Zone G	33%	36%
Generic CARIS Add CC4 Zone G	29%	34%

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	Base	Impact	Base	Impact
WEST (A)	37.97	(0.16)	52.03	(0.32)
GENESSEE (B)	35.82	(0.19)	47.59	(0.32)
CENTRAL (C)	36.78	(0.16)	48.85	(0.32)
NORTH (D)	34.34	(0.18)	46.15	(0.32)
MOHAWKVA (E)	36.49	(0.21)	48.50	(0.36)
CAPITAL (F)	47.00	(0.28)	58.37	(0.31)
HUDSONVA (G)	44.60	(0.48)	57.12	(0.75)
MILLWOOD (H)	45.00	(0.46)	57.70	(0.74)
DUNWOODI (I)	44.93	(0.46)	57.67	(0.74)
NYCITY (J)	45.45	(0.33)	58.13	(0.66)
LONGISLA (K)	48.81	(0.10)	62.27	(0.21)

Impacts on Production Costs ($m)

	2019		2024	
	Base	Impact	Base	Impact
NYCA+Imports-Exports	3,561	(15)	4,339	(39)
Total System	29,763	(19)	41,091	(35)

Source: The Brattle Group analysis using MAPS

A4. Detailed Benefit Analysis: MAPS Analysis
Production Cost Savings for REV Resources

The REV alternative reduces the NPV of production costs by ~$2 billion

- PCS are calculated in 2019 and 2024 using zonal average LBMPs from MAPS
- REV resources are assumed to be phased in from 2016-2020 (20% of total each year); GWh savings shown below apply to years in which full 1,200 MW peak reduction is achieved
- Savings are likely optimistic due to assumption that avoided production costs are equal to LBMP*Energy Savings and high capacity factor of EE (offset by assuming average LBMPs)

Estimated Production Cost Savings of the REV Alternative

	Annual GWh Energy Savings by Zone					Nominal 2019 Savings ($m)	Nominal 2024 Savings ($m)	Measure Life	NPV
Resource Type	G	H	I	J	Total	G-J	G-J	(years)	**(2015 $m)**
Energy Efficiency	598	154	328	4,417	**5,497**	$199	$319	12	**$1,830**
Customer-sited Renewables	31	8	7	53	**98**	$4	$6	25	**$49**
Combined Heat & Power	4	0	0	190	**195**	$7	$11	20	**$89**
Demand Response	0	0	0	0	**0**	$0	$0	10	**$0**
Fossil Fuel Distributed Generation	0	0	0	0	**0**	$0	$0	--	**$0**
Grid Integrated Vehicles	(0)	(0)	(0)	(1)	**(2)**	($0.1)	($0.1)	10	**($0)**
Storage (flywheel and battery)	(1)	(0)	(0)	(3)	**(5)**	($0.2)	($0.3)	15	**($2)**
Rate Structures	0	0	0	0	**0**	$0	$0	15	
Total	**632**	**161**	**335**	**4,656**	**5,783**	**$210**	**$336**		**$1,965**

Sources: REV GEIS. See slide 51 for sources supporting resource distribution and economic life estimates

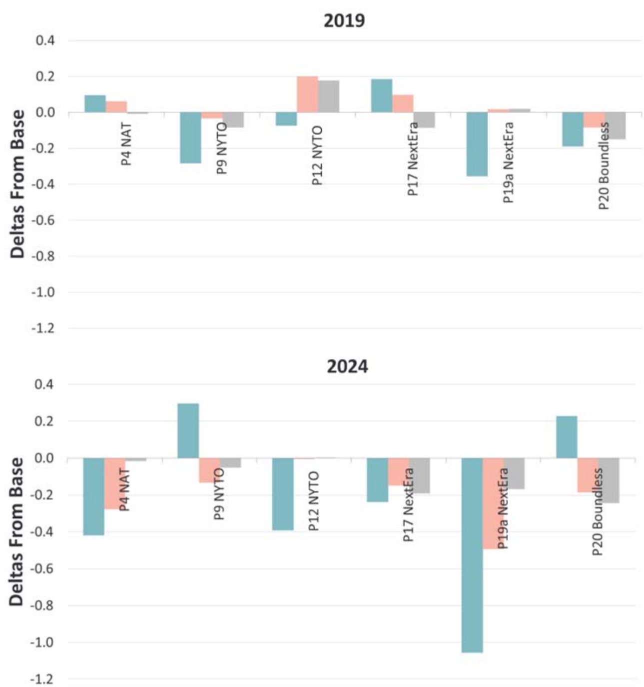
* REV case was not modeled in MAPS, although PCS are calculated using LBMPs from MAPS

Emissions Impacts from MAPS

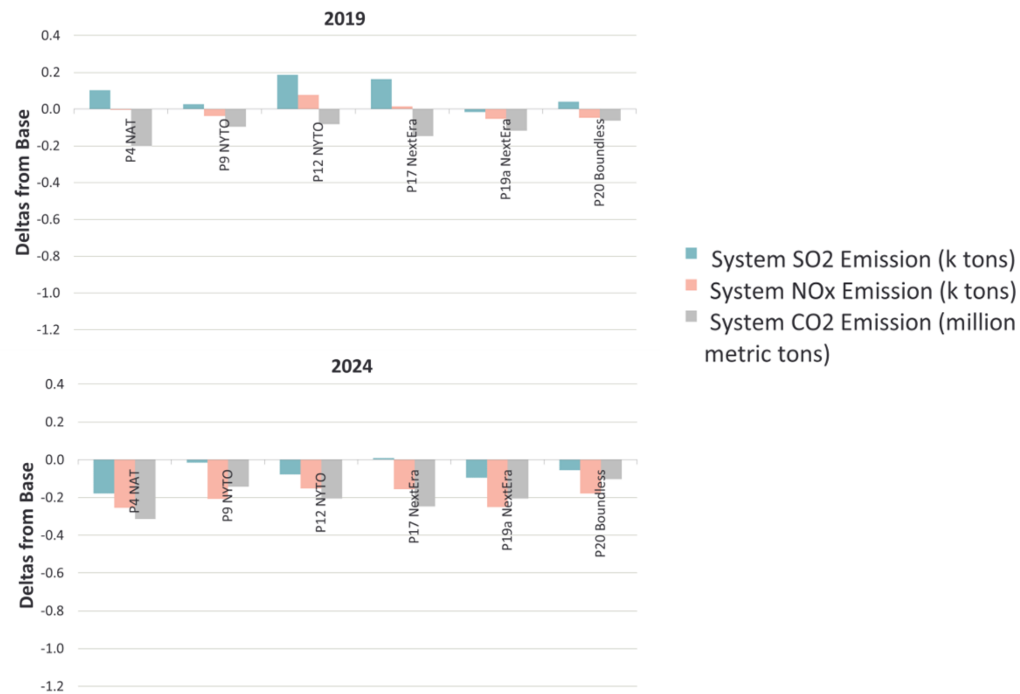
No clear patterns among various portfolios

- Emission allowance prices have small impact on the marginal cost of generation
- CO_2 emission reduction for NYCA across all Change Cases indicates a more efficient dispatch (less fossil fuel usage) with transmission upgrades
- Change in coal unit dispatch (Huntley and Somerset) largely explains the NYCA-wide emissions changes, as described in the following slides

System-wide Change in Emissions



NYCA-wide Change in Emissions



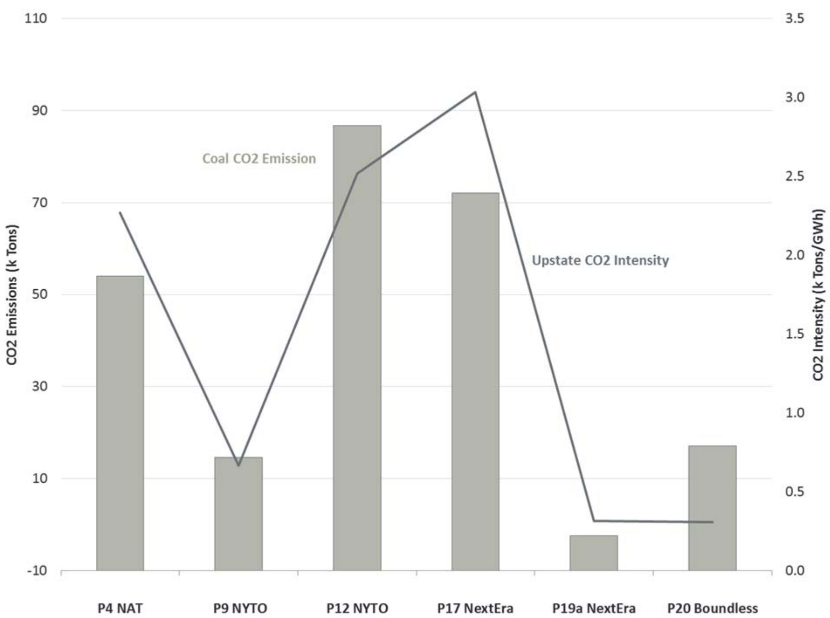
A4. Detailed Benefit Analysis: MAPS Analysis

CO_2 Emissions Impacts

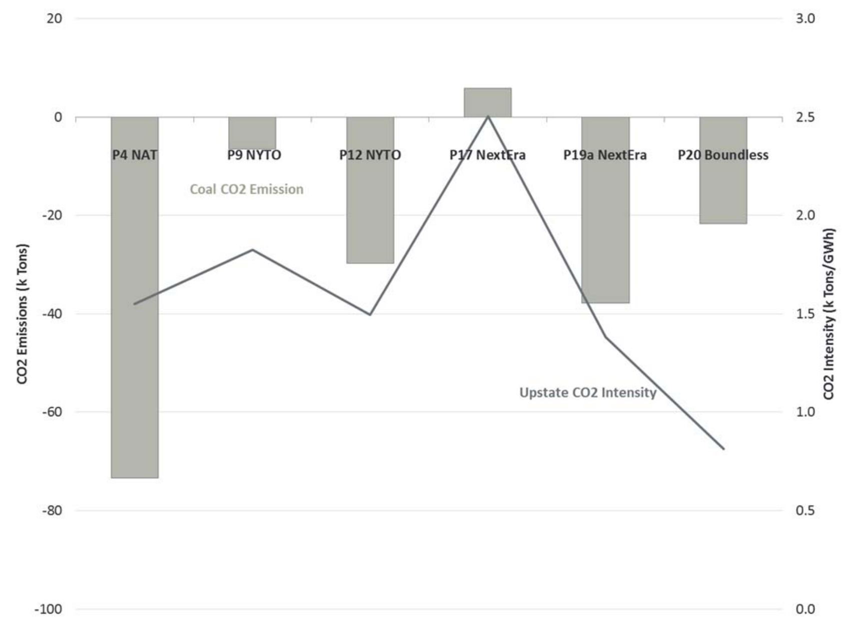
Trends in emissions can be explained largely by changes in generation from coal plants

- Upstate CO_2 Intensity mostly follows changes in Coal Emissions from two representative upstate coal plants (Huntley and AES Somerset).
- Downstate CO_2 Intensity is less than the Base Case in all Change Cases (not shown here)

2019 Coal CO_2 Emissions and Upstate CO_2 Intensity (Deltas from Base Case)



2024 Coal CO_2 Emissions and Upstate CO_2 Intensity (Deltas from Base Case)

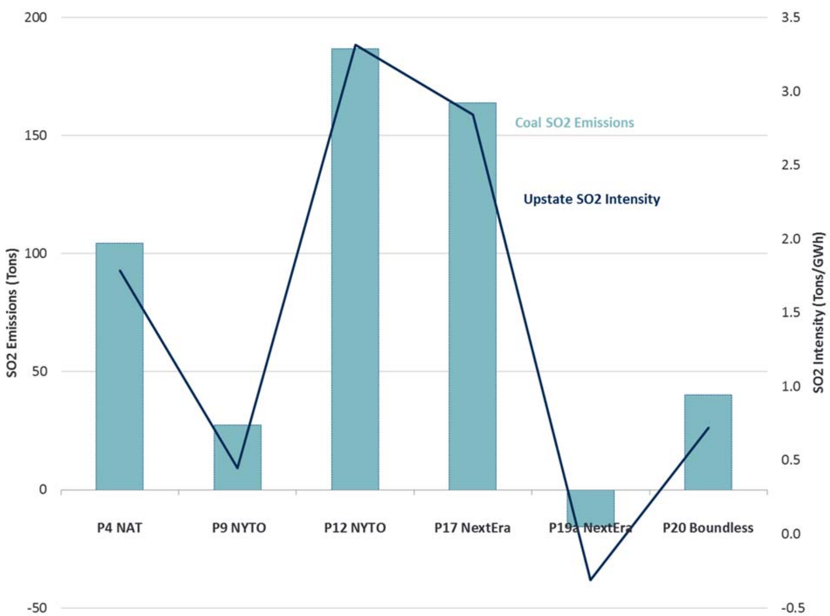


A4. Detailed Benefit Analysis: MAPS Analysis
SO_2 Emissions Impacts

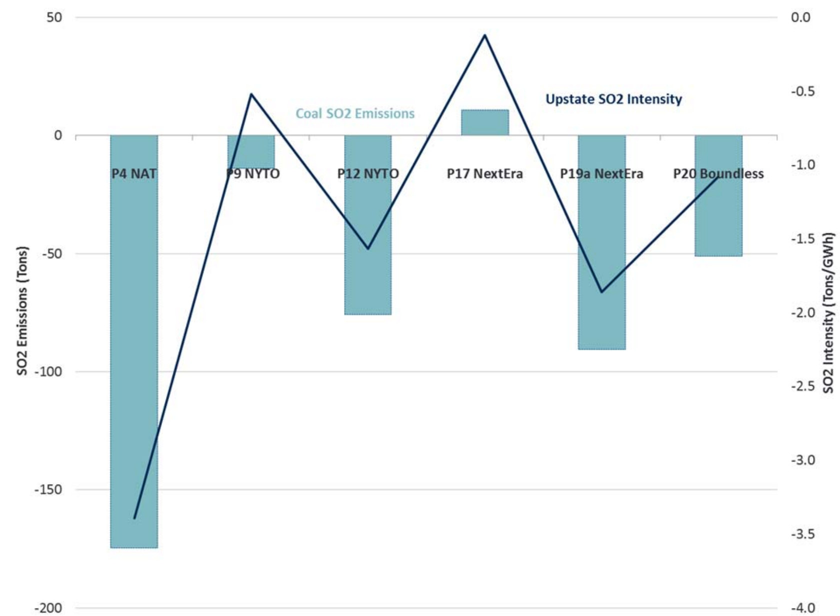
Trends in emissions can largely be explained by changes in generation from coal plants

- Upstate SO_2 Intensity closely follows changes in Coal Emissions from two upstate coal plants (Huntley and AES Somerset)
- Downstate SO_2 Intensity is generally the same as the Base Case (not shown here)

2019 Coal SO_2 Emissions and Upstate SO_2 Intensity (Deltas from Base Case)



2024 Coal SO_2 Emissions and Upstate SO_2 Intensity (Deltas from Base Case)

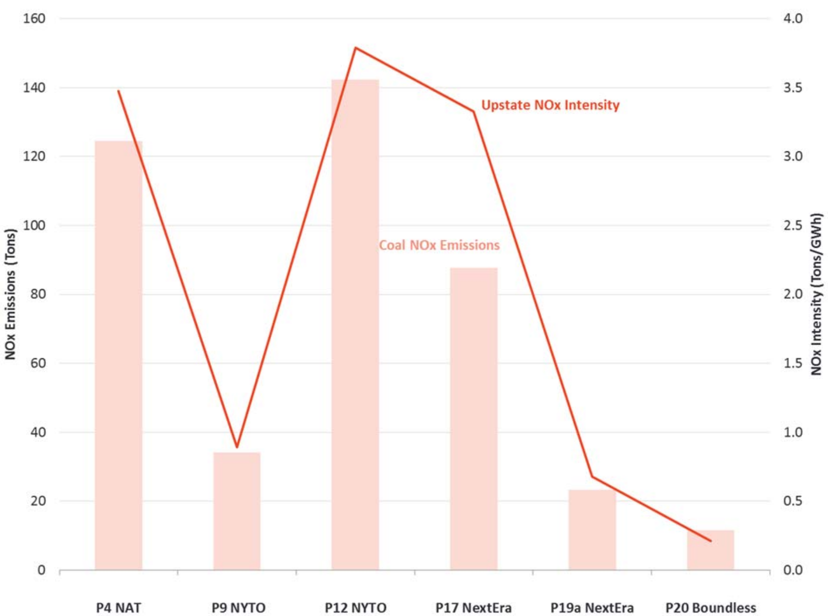


A4. Detailed Benefit Analysis: MAPS Analysis
NOx Emissions Impacts

Trends in emissions can be explained largely by changes in generation from coal plants

- Upstate NOx Intensity mostly follows changes in Coal Emissions from two upstate coal plants (Huntley and AES Somerset)
- Downstate NOx Intensity is less than the Base Case in all Change Cases (not shown here)

2019 Coal NOx Emissions and Upstate NOx Intensity (Deltas from Base Case)



2024 Coal NOx Emissions and Upstate NOx Intensity (Deltas from Base Case)

A4. Detailed Benefit Analysis: MAPS Analysis

Summary of CARIS Metrics

		Base Case		NAT 4		NYTO 9		NYTO 12		NEET 17		NEET 19		Boundless 20		Generation		REV	
		2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024	2019	2024
	units	*Absolute*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*		*delta*	
Production Costs																			
NYCA Adjusted Production	*$m*	3,561	4,339	-34	-42	-4	-10	-27	-32	-28	-34	-6	-14	3	-3	-15	-39	-210	-336
Total System Production	*$m*	29,763	41,091	-34	-41	2	-7	-16	-29	-29	-35	-12	-16	8	-5	-19	-35		
Payments																			
NYCA Generator Payments	*$m*	5,493	7,477	85	118	16	57	62	115	22	48	18	52	4	39	-21	-5		
NYCA Load Payments	*$m*	6,906	9,007	47	36	9	8	21	34	34	26	17	12	11	7	-50	-86		
Congestion Rents																			
NYCA Congestion Rents	*$m*	815	1,059	-95	-150	-16	-71	-83	-138	-40	-83	-8	-65	3	-47	14	23		
Emissions																			
NYCA CO2	*1000 tons*	27,840	30,586	-201	-314	-96	-143	-82	-206	-147	-247	-117	-206	-63	-103	214	624	-1,231	-1,538
	%			-0.7%	-1.0%	-0.3%	-0.5%	-0.3%	-0.7%	-0.5%	-0.8%	-0.4%	-0.7%	-0.2%	-0.3%	0.8%	2.0%		
NYCA SOX	*tons*	2,826	3,517	103	-178	26	-16	186	-78	163	7	-17	-95	40	-54	-112	-5	-1,725	-2,157
	%			3.7%	-5.1%	0.9%	-0.4%	6.6%	-2.2%	5.8%	0.2%	-0.6%	-2.7%	1.4%	-1.5%	-4.0%	-0.1%		
NYCA NOX	*tons*	17,484	18,946	-5	-255	-39	-207	78	-153	16	-157	-54	-251	-47	-179	-532	-625	-1,438	-1,797
	%			0.0%	-1.3%	-0.2%	-1.1%	0.4%	-0.8%	0.1%	-0.8%	-0.3%	-1.3%	-0.3%	-0.9%	-3.0%	-3.3%		
Total System CO2	*1000 tons*	483,295	446,524	-8	-17	-84	-51	178	3	-87	-193	19	-168	-149	-245	-342	-398		
	%			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%		
Total System SOX	*tons*	317,031	289,186	96	-418	-284	295	-74	-392	186	-237	-356	-1,054	-190	228	-1,128	-1,471		
	%			0.0%	-0.1%	-0.1%	0.1%	0.0%	-0.1%	0.1%	-0.1%	-0.1%	-0.4%	-0.1%	0.1%	-0.4%	-0.5%		
Total System NOX	*tons*	330,038	308,250	61	-278	-34	-134	200	-5	97	-148	18	-494	-85	-185	-1,101	-1,529		
	%			0.0%	-0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	-0.2%	0.0%	-0.1%	-0.3%	-0.5%		

Notes:

Red values indicate adverse impacts (such as increasing costs or greater emissions)

NYCA Adjusted Production Cost Savings is defined as Total NYCA+Imports-Exports, with Imports and Exports valued at border LBMPs

ICAP Savings not shown here; see next section of this presentation

REV metrics calculated using MAPS base case LBMPs; emissions from EIS report

A4. Detailed Benefit Analysis: MAPS Analysis

IP Retirement: Assumptions

What would be the production cost savings of new transmission if Indian Point retired in 2019 without forewarning? Compare two scenarios:

- **IP-Out Base Case with Compensating Generation** but takes 3 years to build
  - *Reliability standards not met for the first 3 years* (affects production costs but cost of lower reliability not quantified)
  - 810 MW CCs online by 2022 and 1,020 MW by 2024 to meet reliability standards (7,000 Btu/kWh full load heat rate and $7/MWh VOM, distributed among high voltage buses in Zone G)

	Compensating MW Needed with Indian Point Retirement						
	2016	2019	2020	2021	2022	2023	2024
	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)
2014 CRP Compensatory MW	500						
2014 Gold Book G-J Non-Coincident Summer Peak Load	16,749						
2015 Gold Book G-J Non-Coincident Summer Peak Load	16,441	16,800	16,867	16,957	17,053	17,158	17,263
Change in Load (relative to 2016 in 2014 Gold Book)	-308	51	118	208	304	409	514
Compensatory MW Needs (Rounded up to the nearest 10 MW)	200	560	620	710	810	910	1,020

Sources: 2014 CRP (p. 23); 2014 Gold Book (p. 14); 2015 Long Term Forecast from NYISO .

- **IP-Out with Tx Solution** (modeling in MAPS one representative Tx portfolio)
  - Tx in service prior to IP surprise retirement
  - No compensating generation needed for reliability since Tx provides adequate imports to SENY

While these scenarios relate to the retirement of Indian Point, similar (though less extreme) conclusions could be drawn about other large potential retirements

A4. Detailed Benefit Analysis: MAPS Analysis

IP Retirement: Production Cost and LBMP Impacts

- NYCA-wide production cost savings from the **IP-Out with Tx Solution** scenario as compared to the **IP-Out Base Case with Compensating Generation** scenario are $177m in NPV terms
- 61% of the PV of production cost savings occur in the 3 years w/o compensating generation

Production Cost Savings from Transmission

Production Cost Savings	NPV ($m)	Percent of Total
No Compenating Generation (2019 - 2021)	108	61%
With Compenating Generation (2022 - 2063)	69	39%
Total (2019 - 2063)	177	100%

- Zone G LBMP impact of the **IP-Out with Tx Solution** (compared to the IP-Out Base Case with Compensating Generation starting in 2022) is **-$0.15** in in 2019 but **+$0.60** in 2024
  - LBMPs are lower in 2019 compared to no Tx and no compensating generation (not online yet in alternative case)
  - LBMPs are higher LBMPs in 2024 since Tx avoids adding 1,020 MW of efficient new CCs in G
- Similar effects in surrounding areas

Impacts on Zonal LBMPs ($/MWh)

	2019		2024	
Area	IP-Out Base Case with Compensating Generation	Impact of Tx with IP Out (and no compensating Gen)	IP-Out Base Case with Compensating Generation	Impact of Tx with IP Out (and no compensating Gen)
WEST (A)	39.03	1.30	52.55	1.45
GENESSEE (B)	36.95	1.51	48.30	2.25
CENTRAL (C)	37.99	1.42	49.73	1.87
NORTH (D)	35.31	1.98	46.82	2.56
MOHAWKVA (E)	37.76	1.72	49.38	2.28
CAPITAL (F)	49.13	(0.95)	59.48	0.26
HUDSONVA (G)	47.37	(0.15)	59.01	0.60
MILLWOOD (H)	48.03	(0.48)	59.98	(0.02)
DUNWOODI (I)	47.95	(0.46)	59.95	(0.01)
NYCITY (J)	48.17	(0.43)	60.26	(0.03)
LONGISLA (K)	50.26	(0.31)	63.28	(0.03)

A4. Detailed Benefit Analysis: MAPS Analysis

Present Value of Production Cost Savings

Solution	MAPS 2019 PCS ($m)	MAPS 2024 PCS ($m)	PCS Multiplier	Total 2019 PCS ($m)	Total 2024 PCS ($m)	Production Cost Savings (2015 $m)
P4 NAT (Group E)	$34	$42	x 1.6	$53	$65	$594
P9 NYTO (Group B)	$4	$10	x 1.6	$5	$16	$128
P12 NYTO (Group C)	$27	$32	x 1.6	$42	$50	$460
P17 NextEra (Group D)	$28	$34	x 1.6	$44	$53	$485
P19a NextEra (Group B)	$6	$14	x 1.6	$9	$21	$178
P20 Boundless (Group A)	-$3	$3	x 1.6	-$5	$5	$28
Generation (25 Years)	$15	$39	x 1.24	$19	$48	$401
Generation (45 Years)	$15	$39	X 1.24	$19	$48	$337
REV Resource Solution	$210	$336	GHI: x 1.03 J: x 1.06	$220	$353	$1,965

Note: MAPS PCS listed here are NYCA-wide Adjusted Production Costs savings

ICAP Analysis without CPV Valley

For background on our approach to calculating the capacity resource cost savings for each solution, see slides 91– 96

We include the adjustment for Net Purchases described on slide 92, but not CPV Valley or supply responses to CPV Valley

ICAP MW Impact of Tx Portfolios

We developed with NYISO an approach for estimating the MW impact of the Tx portfolios on LCRs in the Change Case

- For a summary of the approach, see slide 97

Proposed Solution	UPNY/SENY Emergency N-1 Impact (MW)	NYCA IRM Impact (MW)	Zone G-J LCR Impact (MW)	Zone J LCR Impact (MW)	Zone K LCR Impact (MW)
P4 NAT	+1,203	0	-867	-278	-163
P9 NYTO	+1,598	0	-1,025	-293	-172
P12 NYTO	+1,200	0	-872	-279	-164
P17 NextEra	+1,653	0	-1,116	-305	-179
P19a NextEra	+1,528	0	-1,002	-292	-171
P20 Boundless	+588	0	-398	-178	-104

A4. Detailed Benefit Analysis: ICAP Analysis

Summary of Capacity Value

Solution	Capacity Resource Cost Savings (2015 $m)	CARIS Variant 1 (2015 $m)	CARIS Variant 2 (2015 $m)
P4 NAT	$469	$499	$720
P9 NYTO	$494	$539	$897
P12 NYTO	$470	$501	$754
P17 NextEra	$513	$566	$1,014
P19a NextEra	$493	$536	$887
P20 Boundless	$300	$305	$282
Generation (25 yr)*	$602	$681	$1,240
REV Resource Solution	$696	$773	$3,420

Note: Generation capacity value is reduced due to the MOPR

Approach for Estimating Capacity Value of All Tx Portfolios

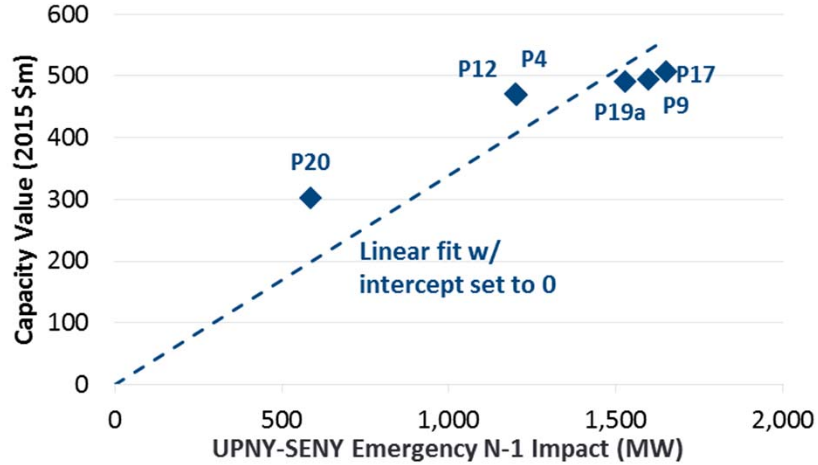
Based on the results for the 6 Tx portfolios we analyzed in the ICAP model:

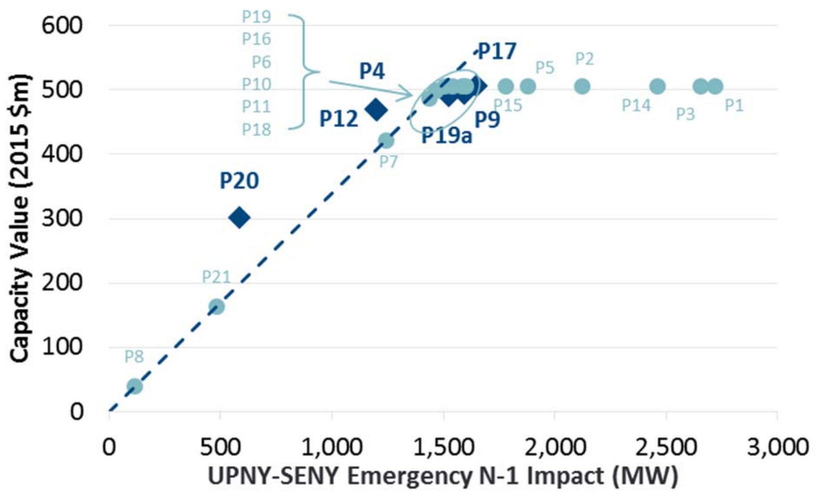
- Found a linear relationship between G-J LCR MW Impacts and the UPNY-SENY Emergency N-1 transfer limit impact
- Fit a linear trend line between the Emergency N-1 transfer limit impact and capacity value

For the other 16 proposed Tx portfolios:

- Estimated their capacity value based on the linear trend line generated in previous step
- Analysis by NYISO found that incremental impacts to the Emergency N-1 transfer limit beyond the 1,653 MW impact of P17 has limited to no effect on the SENY LCRs and its capacity value
- For this reason, the capacity value for projects with Emergency N-1 impacts beyond P17's was set at the P17 capacity value ($506m)

Analysis of Relationship between UPNY-SENY STE Impact and Capacity Value





A4. Detailed Benefit Analysis: ICAP Analysis

Capacity Value of All Tx Portfolios

Group A	UPNY-SENY STE Impact (MW)	Capacity Resource Savings (2015 $m)
P7 - NYTO	1,243	$423
P8 - NYTO	116	$39
P13 - NYTO	-108	$0
P20 - Boundless	**588**	**$300**
P21 - Boundless	482	$164
Group B		
P6 - NYTO	1,544	$513
P9 - NYTO	**1,598**	**$494**
P19 - NextEra	1,601	$513
P19a - NextEra	**1,528**	**$493**
Group C		
P12 - NYTO	**1,200**	**$470**
Group D		
P10 - NYTO	1,507	$513
P11 - NYTO	1,469	$500
P14 - NYTO	2,460	$513
P15 - NextEra	1,780	$513
P16 - NextEra	1,587	$513
P17 - NextEra	**1,653**	**$513**
P18 - NextEra	1,436	$489
Group E		
P1 - NAT	2,722	$513
P2 - NAT	2,122	$513
P3 - NAT	2,657	$513
P4 - NAT	**1,203**	**$469**
P5 - NAT	1,880	$513

Source: UPNY-SENY STE impacts provided by NYISO.

Sensitivity of Capacity Value

Sensitivity Results: The capacity value of the proposed solutions depends on assumptions about the supply curves and the discount rate used to calculate NPV

- **Supply Curve Slope**: Adjusting the estimated slopes of the supply curves by +/- 25% impacts the results for Tx portfolios by **-$8m to +$10m** (-2% to + 2%) on average
- **Discount Rate:** Applying a discount rate of 5.58% increases the value by **$389m**(+85%) on average for the Tx portfolios

Uncertain Capacity Additions and Retirements: The capacity value of the transmission solutions depends on excess UPNY capacity being available as well as the difference in the cost of new entry between UPNY and SENY; for this reason, we analyzed the change in capacity value across the following conditions

Scenario	Average Impact on Transmission Capacity Value ($m)
2,000 MW Retires in SENY	+$280
500 MW Retires in SENY	+$160
500 MW Retires in UPNY	-$80
2,000 MW Retires in UPNY	-$210

Maintaining Reliability with Major Retirements

In addition to reduced capacity costs, the additional transfer capability into SENY provided by the Tx solutions will increase the flexibility to accommodate generation retirements without falling below LCRs

Additional Capacity Retirement Flexibility of Proposed Solutions (MW)

Portfolio	G-J	J	K	Total
P4 NAT	867	278	163	**1,030 MW**
P9 NYTO	1,025	293	172	**1,197 MW**
P12 NYTO	872	279	164	**1,036 MW**
P17 NextEra	1,116	305	179	**1,295 MW**
P19a NextEra	1,002	292	171	**1,173 MW**
P20 Boundless	398	178	104	**502 MW**

Note: Total is calculated based on sum of G-J and K since J is nested in G-J.

Summary of Avoided Refurbishment Costs

Type of Project Elements	Avoided "Base Case" Cost	Approach to Quantifying	P4 NAT ($m)	P9 NYTO ($m)	P12 NYTO ($m)	P17 NextEra ($m)	P19a NextEra ($m)	P20 Boundless ($m)
Project Elements Upgrade Existing Lines	Ongoing taxes and O&M costs	Credit equals the present value of the avoided revenue requirements of existing lines upgraded (*Note: Cost only avoided until date line planned to be refurbished in Base Case, if refurbished at all.*)	**$87** Replace KB-PV	**$112** Reconductor NS-LD and replaces LD-PV	**$135** Retire PR-RM; reconductor NS-LD and LD-PV	**$80** Retire PR-RM, rebuild NS-ALPS, and replace GRB-PV	**$41** Replace GRB-PV	**$157** Reconductor LD-PV, HA-LD, and CPV-RT
Project Elements Replace Aging Lines that will have to be replaced anyway	Future Refurbishment costs	Credit equals the present value of future revenue requirements for refurbishments	–	**$148** Retires Leeds-PV 115 kV Lines	**$739** Retires 2 P-R Lines	**$961** Retires 2 P-R Lines & Retires 2 G-PV 115 kV Lines	**$223** Retires 2 G-PV 115 kV Lines	–
Project Elements Provide Parallel Paths to Aging Lines that will have to be replaced in the future	Congestion during Construction	Aging lines are predominantly 115 kV rated, and were expected to have very low production cost/congestion impact	–	–	–	–	–	–
	Construction Costs due to Extended Construction Schedule	**Base Analysis** conservatively assume no costs avoided	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
		Sensitivity Analysis avoid 20% of costs due to normal construction schedule; credit equals the present value of future revenue requirements for refurbishments	**$112** Avoids costly constr. of 6 115kV Lines in NS-L-PV Corridor	**$91** Avoids costly constr. of 6 115kV Lines in L-PV Corridor	–	**$91** Avoids costly constr. of 6 115kV Lines in L-PV Corridor	**$91** Avoids costly constr. of 6 115kV Lines in L-PV Corridor	–

A4. Detailed Benefit Analysis: Avoided Tx Costs

Existing Lines

Tx Portfolio	Facility Upgraded	Type of Upgrade	Assumed Refurbishment Year	Replacement Costs (2015$)	PVRR of Avoided Costs (2015$)
P4 NYTO	KN - PV 115 kV	Replaced	2030	$482m	**$87**
P9 NYTO	NS - LD 115 kV	Reconductor	N/A	$171m	**$112**
	LD - PV 115 kV	Replaced	2030	$312m	
P12 NYTO	PT - RM 230 kV	Retired	2020	$396m	**$135**
	NS - LD 115 kV	Reconductor	N/A	$171m	
	LD - PV 115 kV	Reconductor	N/A	$214m	
P17 NYTO	PT - RM 230 kV	Retired	2020	$396m	**$80**
	NS - ALPS 115 kV	Reconductor	N/A	$91m	
	GB - PV 115 kV	Replaced	2030	$230m	
P19a NextEra	GB - PV 115 kV	Replaced	2030	$230m	**$41**
P20 Boundless	LD - PV 115 kV	Reconductor	N/A	$246m	**$157**
	HA - LD 115 kV	Reconductor	N/A	$128m	
	CPV - RT 115 kV	Reconductor	N/A	$107m	

Notes:

Assume RevReq for existing lines would be required through 2063 unless the line is aging and projected to be refurbished in year shown (see next section for more details).

PVRR of avoided costs calculated by reducing O&M costs in RevReq workbook proportional to 1 minus the ratio of Replacement Costs over Portfolio Capital Costs and calculating the change in the RevReq.

A4. Detailed Benefit Analysis: Avoided Tx Costs

Avoided Costs of Refurbishing Aging Lines

Project	Aging Transmission Facility (identifed in STARS 2012 Report)	Estimated Year of Refurbishment	Proposed Refurbishment	Refurbishment Mileage	Avoided Capital Costs (mid-2015 $m)	Avoided Investment Cost (Mid-Year before Investment $m)	Avoided PVRR (Mid-Year before Investment $m)	Avoided PVRR (mid-2015 $m)
P4 – NAT	None		None		-	-	-	-
P9 - NYTO	Leeds - Pleasant Valley 115 kV (2 Lines)	2030	Replacement	82	**$212**	**$305**	**$502**	**$148**
P12 – NYTO	Porter - Rotterdam 230 kV (2 Lines)	2020	Retirement	140	**$560**	**$636**	**$1,048**	**$739**
P17 – NextEra	Porter - Rotterdam 230 kV (2 Lines)	2020	Retirement	140	**$560**	**$636**	**$1,048**	**$739**
	Greenbush - N. Churchtown - Pleasant Valley 115 kV (2 lines)	2030	Retirement	124	**$319**	**$459**	**$757**	**$223**
	Total				**$879**		**$1,804**	**$961**
P19a – NextEra	Greenbush - N. Churchtown - Pleasant Valley 115 kV (2 lines)	2030	Retirement	124	**$319**	**$459**	**$757**	**$223**
P20 – Boundless	None		None		-	-	-	-

Notes:

Assumed lines to be replaced in STARS report in 0 – 10 years occur in 2020 and 11 – 20 years occur in 2030.

Assumed all identified aging facilities will require a full rebuild to calculate the avoided capital cost; used generic equipment cost of $2.6m for a 115 kV Tx rebuild to calculate avoided capital cost for 115 kV Lines.

See slides 46 – 47 for an explanation of how we convert 2015 overnight costs to PVRR in 2015$.

A4. Detailed Benefit Analysis: Avoided Tx Costs

Avoided Construction Costs by Adding Parallel Line

Portfolio	Facilities Proposed	Aging Lines whose Refurbishment is Enabled by Proposed Facility	Proposed Refurbishment	Estimated Year of Refurbishment	Refurbishment Mileage	Estimated Cost of Refurbishment (mid-2015 $m)	20% of Estimated Refurbishment Costs (mid-2015 $m)	Avoided Investment Costs (Mid-Year before Investment $m)	Avoided PVRR (Mid-Year before Investment $m)	Avoided PVRR (mid-2015 $m)
P4 – NAT	**New Scotland to Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		GB-NC-PV 115 kV (2 lines)	Rebuild	2030	124	$319	$64	$92	$151	$44
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		Total				**$801**				**$112**
P9 – NYTO	**Leeds - Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P12 – NYTO	**None**	-	-	-	-	-	-	-	-	-
P17 – NextEra	**Knickerbocker to Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P19a – NextEra	**Greenbush - Pleasant Valley 345 kV**	LD-PV 115 kV (2 lines)	Rebuild	2030	80	$205	$41	$59	$97	$29
		KN-PV 115 kV (2 lines)	Rebuild	2030	108	$278	$56	$80	$132	$39
		NC-PV 115 kV (2 lines)	Rebuild	2030	65	$166	$33	$48	$79	$23
		Total				**$648**	**$130**			**$91**
P20 – Boundless	**None**	-	-	-	-	-	-	-	-	-

Notes:

Assumed lines to be replaced in 11 – 20 years in STARS report occur in 2030.

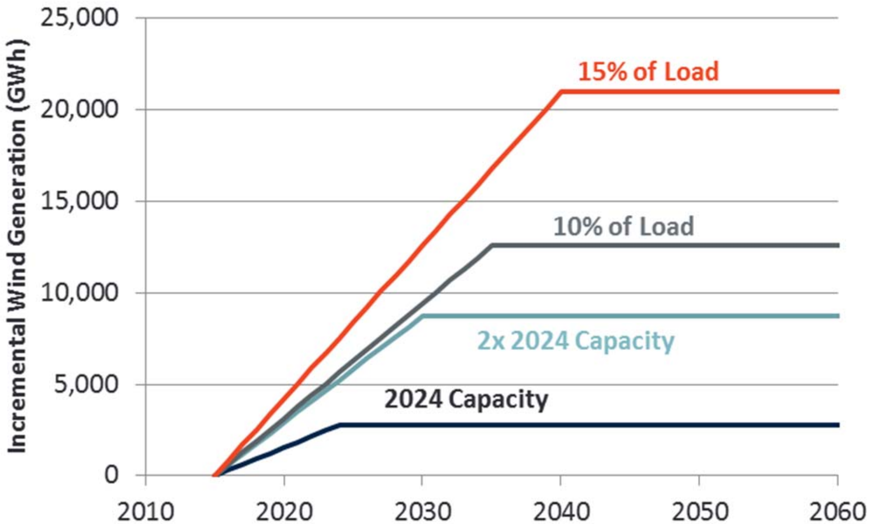
Assumed all identified aging facilities will require a full rebuild to calculate the avoided capital cost; used generic equipment cost of $2.6m for a 115 kV Tx rebuild to calculate avoided capital cost for 115 kV Lines.

See slides 46 – 47 for an explanation of how we convert 2015 overnight costs to PVRR in 2015$.

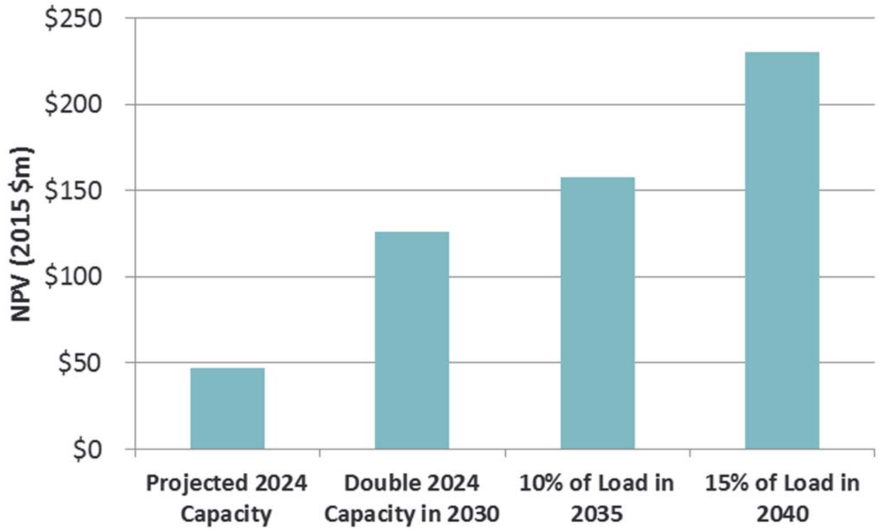
Summary of RPS/CO_2 Benefits

Depending on the assumed goals, the savings for P12 in 2024 could be $5m to $13m with an NPV of $39m to $188m in benefits with an average of $115m

Future RPS Scenarios



NPV for P12 of Future RPS Scenarios



RPS/CO2 Benefits of Transmission Portfolios ($m)

RPS	P4	P9	P12	P17	P19a	P20
Low	$47	$10	$39	$40	$10	$5
2x 2024	**$125**	**$28**	**$103**	**$107**	**$27**	**$15**
High	$228	$51	$188	$194	$51	$29

Increased Employment During Construction

Investment in new transmission facilities will have employment impacts in the regions in which the facilities are built

- Based on previous analysis using NREL's JEDI model, every $1m in transmission investment results in 6.6 full-time equivalent ("FTE") jobs during construction
- 60% of jobs are directly associated with the project and the remaining 40% indirect or induced
- The capital costs of the proposed solutions range from $300 to $1,100m, which would be expected to result in 2,100 to 7,500 FTEs

This does not account for the effects of rate impacts on customer spending and associated economic activity

Also, does not include employment benefits from ongoing transmission maintenance and improved viability of upstate generators

- Near term, we project upstate generator revenues to increase by $1 – 2/kW-mo
- Long term, we project 800 – 1,000 MW of additional UPNY capacity

Increased Revenues to Upstate Generators ($/kW-mo)

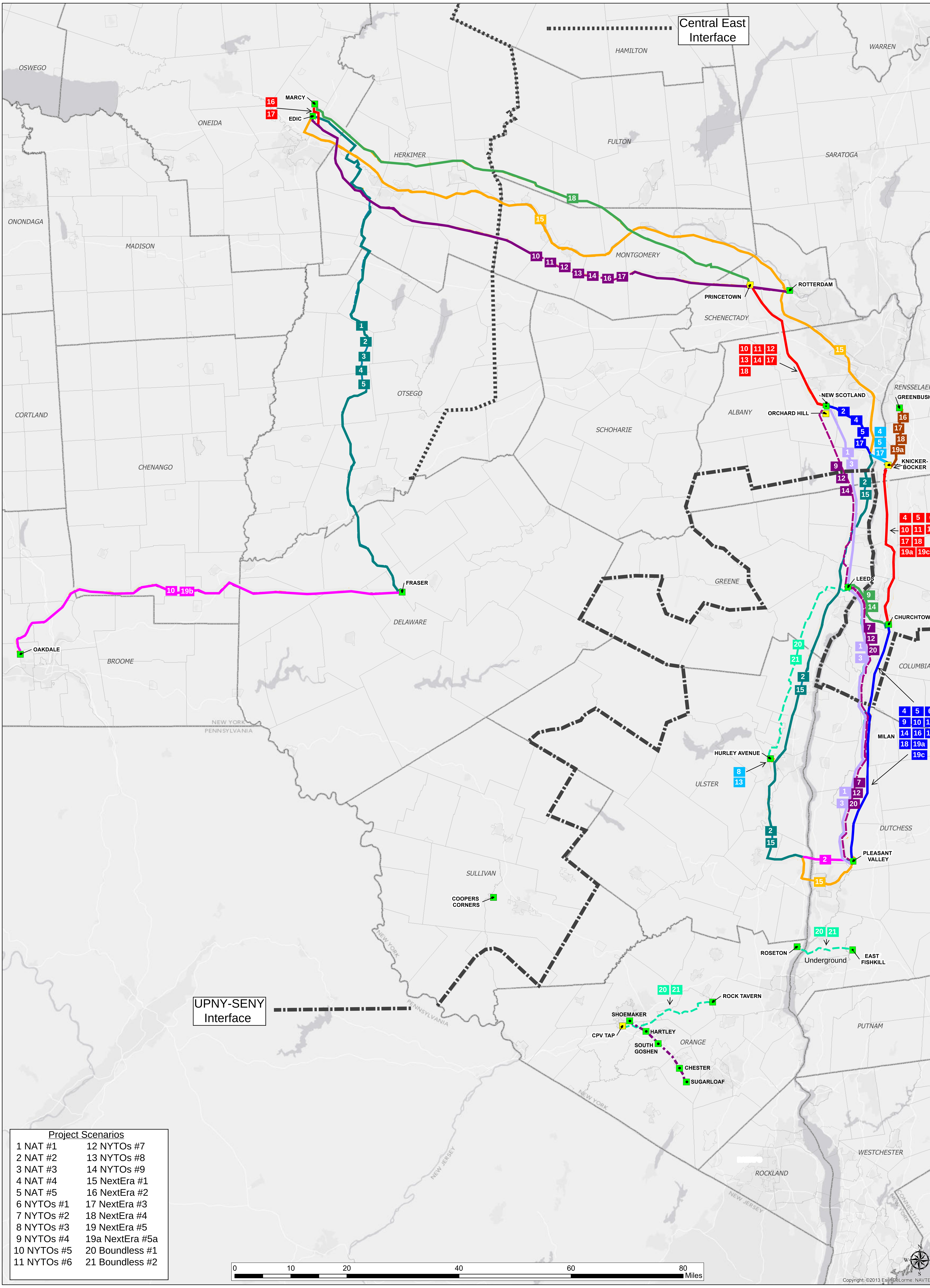
Unit Type	Capacity Factor	LBMP Impact $1/MWh	LBMP Impact $2/MWh	Capacity Revenues	Total
Nuclear	95%	$0.7	$1.4	$0.5 - 1.0	$1.2 - 2.4
CC	60%	$0.4	$0.9	$0.5 - 1.0	$0.9 - 1.9
Oil/Gas Steam	40%	$0.3	$0.6	$0.5 - 1.0	$0.8 - 1.6

Appendix B
Acronyms

Project Related Acronyms and Associated Descriptions

Acronym	Description
CPV-RT	*CPV Tap - Rock Tavern 345 kV Line*
ED-FR	*Edic - Fraser 345 kV Line*
ED-NS	*Edic - New Scotland 345 kV Line*
FR-G	*Fraser - Gilboa 345 kV Line*
FR-G SC	*Series Compensation of Fraser - Gilboa 345 kV Line*
Fraser tie M-CC	*Looping Marcy - Coopers Corner 345 kV Line into Fraser 345 kV Substation*
KN-PV	*Knickerbocker - Pleasant Valley 345 kV Line*
LD-HA	*Leeds - Hurley 345 kV Line*
LD-PV	*Leeds - Pleasant Valley 345 kV Line*
M-NS	*Marcy - New Scotland 345 kV Line*
M/ED-NS SC	*Series Compensation of Marcy/Edic - New Scotland 345 kV Line*
NC-PV	*North Churchtown - Pleasant Valley 115 kV Line*
NS-PV	*New Scotland - Pleasant Valley 345 kV Line*
NS-LD	*New Scotland - Leeds 345 kV Line*
NS-LD-PV(R)	*Reconductoring New Scotland - Leeds - Pleasant Valley 345 kV Line*
NS-LD SR	*Series Reactor on New Scotland - Leeds 345 kV Line*
PT-RM	*Porter - Rotterdam 230 kV Line*

APPENDIX 2



Overhead Line = Solid
Reconductored Line = Dashed
Underground Line = Dashed Labeled Underground
Add-on Line = Dash Dot Dash Dot

AC Transmission Upgrades Proceeding
Case 13-E-0488

(Proposed Transmission Lines)

Project Substations/Switchyards

Proposed

Existing

September 22, 2015

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APPENDIX 3

UPNY/SENY Delta for All Projects

Case	UPNY-SENY NTC	UPNY-SENY NTC Delta	Limiting Element	Limiting Contingency
Base	**5113**		Leeds - Pleasant Valley 345	T 34&42B
Base	5148		CPV - Rock Tavern 345	CC- Rock Tavern & Roseton - Rock Tavern 345
P1	7219	2106	CPV - Rock Tavern 345	SB Coopers 34_B382 (CC-Rock Tavern 345, Middletown-Shoemaker 138, Cooper 345/115)
P2	6823	1710	Leeds - Pleasant Valley 345	T 34&42B
P3	7251	2138	Fraser - Coopers Corners 345	Fraser - Coopers Corners 345
P4	6576	1463	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P5	6637	1524	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P6	6031	918	Roseton - E. Fishkill 345	T 77&76
P7	5465	352	Roseton - E. Fishkill 345	T 77&76
P8	4783	-330	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P9	6151	1038	Roseton - E. Fishkill 345	T 77&76
P10	6319	1206	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P11	6052	939	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P12	5545	432	Roseton - E. Fishkill 345	T 77&76
P13	4784	-329	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P14	TBD*	TBD	Roseton - E. Fishkill 345	T 77&76
P15	TBD	TBD	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P16	TBD	TBD	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P17	TBD	TBD	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P18	TBD	TBD	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345
P19a	6074	961	Roseton - E. Fishkill 345	T 77&76
P20	5128	15	Roseton - W. Fishkill 345	SB Roseton 345 8
P20	5800	687	Hurley - Roseton 345	T 34&42B
P21	5032	-81	Roseton - W. Fishkill 345	SB Roseton 345 8
P21	5718	605	Hurley - Roseton 345	T 34&42B

*These results will be provided prior to the Technical Conferences

UPNY/SENY Delta for All Projects

Case	UPNY-SENY ETC	UPNY-SENY ETC Delta	Limiting Element	Limiting Contingency
Base	5319		CPV - Rock Tavern 345	Coopers Corners - Rock Tavern 345 (#34)
Base	5425		Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P1	7704	2385	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P2	7590	2271	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P3	7028	1709	Fraser - Coopers Corners 345 #1	Fraser - Coopers Corners 345 #2
P4	7546	2227	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P5	7420	2101	Fraser - Coopers Corners 345 #1	Fraser - Coopers Corners 345 #2
P6	7005	1686	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P7	6723	1404	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P8	5555	236	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P9	7410	2091	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P10	7226	1907	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P11	6940	1621	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P12	6660	1341	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P13	5534	215	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P14	TBD*	TBD	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P15	TBD	TBD	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P16	TBD	TBD	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P17	TBD	TBD	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P18	TBD	TBD	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P19a	7066	1747	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P20	7072	1753	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P21	6752	1433	Leeds-Pleasant Valley 345	Leeds-Hurley

*These results will be provided prior to the Technical Conferences

EHAC Thermal and Voltage Transfer Analysis
Second Round - CPV In-Service

	Thermal				NTC		ETC	
Case	UPNY-SENY NTC	UPNY-SENY ETC	UPNY-SENY NTC Delta	UPNY-SENY ETC Delta	Limiting Element	Limiting Contingency	Limiting Element	Limiting Contingency
Base	5113	5319			Leeds - Pleasant Valley 345	T 34&42B	CPV - Rock Tavern 345	Coopers Corners - Rock Tavern 345 (#34)
Base	5148	5425			CPV - Rock Tavern 345	CC- Rock Tavern & Roseton - Rock Tavern	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P6	6031	7005	918	1686	Roseton - E. Fishkill 345	T 77&76	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P7	5465	6723	352	1404	Roseton - E. Fishkill 345	T 77&76	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P9	6151	7410	1038	2091	Roseton - E. Fishkill 345	T 77&76	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P11	6052	6940	939	1621	Leeds - Pleasant Valley 345	Athens - Pleasant Valley 345	Leeds-Pleasant Valley 345	Athens - Pleasant Valley 345
P12	5545	6660	432	1341	Roseton - E. Fishkill 345	T 77&76	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P14	6249	7605	1136	2286	Roseton - E. Fishkill 345	T 77&76	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P19a	6074	7066	961	1747	Roseton - E. Fishkill 345	T 77&76	Leeds-Pleasant Valley 345	Athens - Pleasant Valley
P20	5128	7072	15	1753	Roseton - W. Fishkill 345	SB Roseton 345 8	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P20	5800	7072	687	1753	Hurley - Roseton 345	T 34&42B	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
P21	5032	6752	-81	1433	Roseton - W. Fishkill 345	SB Roseton 345 8	Leeds-Pleasant Valley 345	Leeds-Hurley
P21	5718	6752	605	1433	Hurley - Roseton 345	T 34&42B	Leeds-Pleasant Valley 345	Leeds-Hurley

Notes: Assumes Athens SPS in-service in base case and out-of-service in project cases
Base NTC limit on Leeds-PV LTE is correct because it is for a tower contingency that does not involve the loss of a Leeds South line
If Athens SPS were out-of-service in the base case, the NTC limit would be 4685 MW on Leeds-PV for loss of Athens-PV
Assumes Rock Tavern terminal upgrades are included in all project cases (not the base case)
For P20, the Gilboa-Leeds limit is ignored due to an NYSRC exception allowing the line to be secured to STE when 4 Gilboa units are on.
Assumes limitation on Shoemaker-Chester-Sugarloaf 138 kV line has been addressed.

Central East Voltage

	CPV Off	CPV On	CPV Delta	Project Delta
Base	2700	2725	25	
P6	2750	2825	75	100
P7	2650	2750	100	25
P9	2725	2775	50	50
P11	3150	3100	-50	375
P12	3050	3100	50	375
P14	3050	3100	50	375
P19a	2750	2775	25	50
P20	2650	2700	50	-25
P21	2650	2700	50	-25

EHAC Thermal and Voltage Transfer Analysis
Second Round - CPV In-Service

UPNY/SENY Impact of Combination Projects

Thermal					NTC		ETC	
Case	UPNY-SENY NTC	UPNY-SENY ETC	UPNY-SENY NTC Delta	UPNY-SENY ETC Delta	Limiting Element	Limiting Contingency	Limiting Element	Limiting Contingency
Base	5113	5319			Leeds - Pleasant Valley 345	T 34&42B	CPV - Rock Tavern 345	Coopers Corners - Rock Tavern 345 (#34)
Combo 1: P14&21a	6767	7523	1654	2204	CPV - Rock Tavern 345	SB: Rock Tavern 345 31153 (L/O Roseton - Rock Tavern & Coopers - Rock Tavern)	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
Combo 3: P9&P21a	6593	7332	1480	2013	CPV - Rock Tavern 345	SB: Rock Tavern 345 31153 (L/O Roseton - Rock Tavern & Coopers - Rock Tavern)	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345
Combo 5: P11&21a	6426	7145	1313	1826	CPV - Rock Tavern 345	SB: Rock Tavern 345 31153 (L/O Roseton - Rock Tavern & Coopers - Rock Tavern)	Fraser - Coopers Corners 345	Marcy - Coopers Corners 345

Notes: Assumes Athens SPS in-service in base case and out-of-service in project cases
Base NTC limit on Leeds-PV LTE is correct because it is for a tower contingency that does not involve the loss of a Leeds South line
If Athens SPS were out-of-service in the base case, the NTC limit would be 4685 MW on Leeds-PV for loss of Athens-PV
Assumes Rock Tavern terminal upgrades are included in all project cases (not the base case)

Central East Voltage

	CPV On	Project Delta
Base	2725	
Combo 1	3100	375
Combo 2	3125	400
Combo 3	2775	50
Combo 4	2725	0

APPENDIX 4

DPS Staff Construction Cost Estimates

Without CPV Valley in Base Case

OLD	Applicant	Description	Construction Cost Estimate Applicant	Construction Cost Estimate DPS Staff
P1	NAT	ED-FR; NS-L Adjacent; LD-PV Adjacent	$521,850,000	$710,645,283
P2	NAT	ED-FR; NS-L I87; LD-PV I87	$717,850,000	$873,816,732
P3	NAT	ED-FR; NS-L Adjacent; LD-PV Adjacent	$563,308,000	$764,540,683
P4	NAT	ED-FR; KB-PV 115 kV; NS-KB	$930,391,000	$1,134,324,240
P5	NAT	ED-FR; KB-PV 115 kV; NS-KB	$886,559,000	$1,077,342,640
P6	NYTOs	KB-PV	$470,073,842	$484,156,714
P7	NYTOs	LD-PV(R)	$212,431,390	$214,221,527
P8	NYTOs	Hurley Ave PARS	$95,182,849	$79,453,075
P9	NYTOs	NS-LD(R); LD-PV	$488,272,770	$484,047,291
P10	NYTOs	ED-NS; KB-PV; O-F	$1,257,710,880	$1,292,270,175
P11	NYTOs	ED-NS; KB-PV	$1,047,171,098	$1,041,896,308
P12	NYTOs	ED-NS; NS-LD-PV(R)	$957,741,757	$943,271,234
P13	NYTOs	ED-NS+Hurley Ave PARS	$701,386,806	$675,662,139
P14	NYTOs	ED-NS; NS-LD(R); LD-PV	$1,091,735,727	$1,071,417,655
P15	NextEra	ED-LD-PV Thruway Route plus Oakdale-Fraser	$704,477,747	$902,402,809
P16	NextEra	MY/ED-PV Southern Route 1 plus Oakdale Fraser	$671,059,221	$894,257,553
P17	NextEra	MY/ED-PV Southern Route 2 plus Oakdale Fraser	$812,082,493	$1,076,198,551
P18	NextEra	MY/ED-PV Northern Route plus Oakdale Fraser	$626,598,027	$861,014,523
P19	NextEra	GRB-KN-CH-PV plus Oakdale Fraser	$355,497,426	$498,421,652
P19a	NextEra	GRB-KN-CH-PV	$239,237,312	$313,955,417
P20	Boundless	CPV-RT; RS-EF; LD-HA(R); LD-PV(R); LD-AG-PV(R)	$697,715,587	$878,905,890
P21	Boundless	CPV-RT; RS-EF; LD-HA(R)	$470,526,682	$632,472,003

GLOBAL ADDITIONS (NAT/NYTOs/NextEra)	
Chester-Shoemaker Upgrade	$88,000,000
Rock Tavern Terminal Upgrades	$25,000,000
Subtotal	**$113,000,000**
Contingency at 30%	$33,900,000
Total Global Additions (NAT/NYTOs/NextEra):	**$146,900,000**

GLOBAL ADDITIONS (Boundless)	
Roseton Terminal Upgrades	$30,000,000
Subtotal	**$30,000,000**
Contingency at 30%	$9,000,000
Total Global Additions (Boundless):	**$39,000,000**

With CPV Valley in Base Case and Rock Tavern/Chester-Sugarloaf Line Costs

NEW		Description	Applicant	DPS Staff
P1	NAT	ED-FR; NS-L Adjacent; LD-PV Adjacent	$668,750,000	$857,545,283
P2	NAT	ED-FR; NS-L I87; LD-PV I87	$864,750,000	$1,020,716,732
P3	NAT	ED-FR; NS-L Adjacent; LD-PV Adjacent	$710,208,000	$911,440,683
P4	NAT	ED-FR; KB-PV 115 kV; NS-KB	$1,077,291,000	$1,281,224,240
P5	NAT	ED-FR; KB-PV 115 kV; NS-KB	$1,033,459,000	$1,224,242,640
P6	NYTOs	KB-PV	$616,973,842	$631,056,714
P7	NYTOs	LD-PV(R)	$359,331,390	$361,121,527
P8	NYTOs	Hurley Ave PARS	$242,082,849	$226,353,075
P9	NYTOs	NS-LD(R); LD-PV	$635,172,770	$630,947,291
P10	NYTOs	ED-NS; KB-PV; O-F	$1,404,610,880	$1,439,170,175
P11	NYTOs	ED-NS; KB-PV	$1,194,071,098	$1,188,796,308
P12	NYTOs	ED-NS; NS-LD-PV(R)	$1,104,641,757	$1,090,171,234
P13	NYTOs	ED-NS+Hurley Ave PARS	$848,286,806	$822,562,139
P14	NYTOs	ED-NS; NS-LD(R); LD-PV	$1,238,635,727	$1,218,317,655
P15	NextEra	ED-LD-PV Thruway Route	$735,117,633	$864,836,574
P16	NextEra	MY/ED-PV Southern Route 1	$701,699,107	$856,691,318
P17	NextEra	MY/ED-PV Southern Route 2	$842,722,379	$1,038,632,316
P18	NextEra	MY/ED-PV Northern Route	$657,237,913	$823,448,288
P19a	NextEra	GRB-KN-CH-PV	$386,137,312	$460,855,417
P19b	NextEra	Oakdale-Fraser	$263,160,114	$331,366,235
P19c	NextEra	KN-CH-PV	$386,137,312	$460,855,417
P20	Boundless	CPV-RT; RS-EF; LD-HA(R); LD-PV(R); LD-AG-PV(R)	$736,715,587	$917,905,890
P21	Boundless	CPV-RT; RS-EF; LD-HA(R)	$509,526,682	$671,472,003

APPENDIX 5

SEGMENT A

Edic/Marcy to New Scotland; Princetown to Rotterdam
Construction of a new 345 kV line from Edic or Marcy to New Scotland on existing right-of-way (primarily using Edic to Rotterdam right-of-way west of Princetown); construction of two new 345 kV lines or two new 230 kV lines from Princetown to Rotterdam on existing Edic to Rotterdam right-of-way; decommissioning of two 230 kV lines from Edic to Rotterdam; related switching or substation work at Edic or Marcy, Princetown, Rotterdam, and New Scotland.

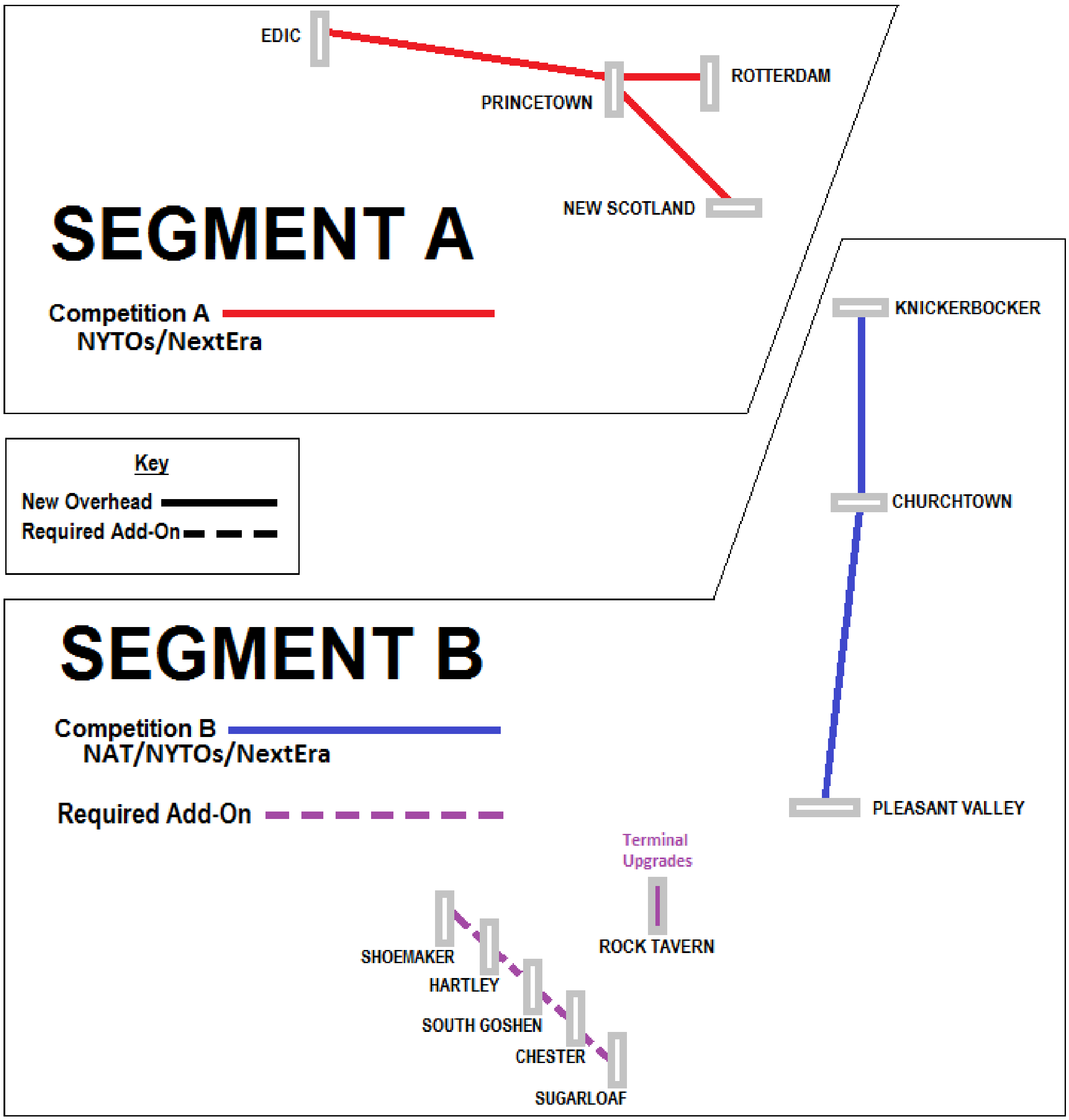
SEGMENT B

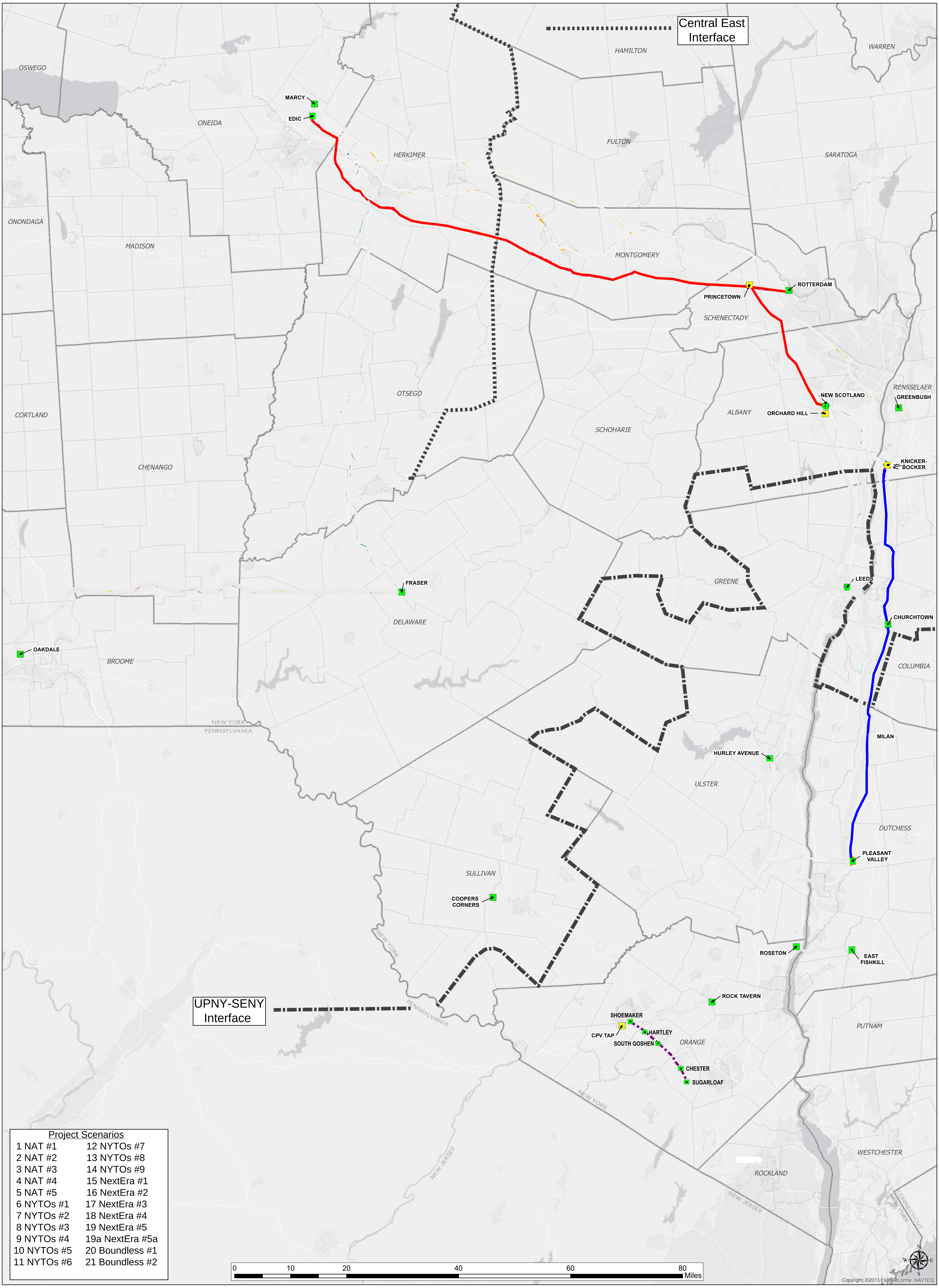
Knickerbocker to Pleasant Valley
Construction of a new double circuit 345 kV/115 kV line from Knickerbocker to Churchtown on existing Greenbush to Pleasant Valley right-of-way; construction of a new double circuit 345 kV/115 kV line or triple circuit 345 kV/115 kV/115 kV line from Churchtown to Pleasant Valley on existing Greenbush to Pleasant Valley right-of-way; decommissioning of a double-circuit 115 kV line from Knickerbocker to Churchtown; decommissioning of one or two double-circuit 115 kV lines from Knickerbocker to Pleasant Valley; related switching or substation work at Greenbush, Knickerbocker, Churchtown and Pleasant Valley.

Upgrades to the Rock Tavern Substation
New line traps, relays, potential transformer upgrades, switch upgrades, system control upgrades and the installation of data acquisition measuring equipment and control wire needed to handle higher line currents that will result as a consequence of the new Edic/Marcy to New Scotland; Princetown to Rotterdam and Knickerbocker to Pleasant Valley lines.

Shoemaker to Sugarloaf
Construction of a new new double circuit 138 kV line from Shoemaker to Sugarloaf on existing Shoemaker to Sugarloaf right-of-way; decommissioning of a double circuit 69 kV line from Shoemaker to Sugarloaf; related switching or substation work at Shoemaker, Hartley, South Goshen, Chester, and Sugarloaf.

SCHEMATIC LAYOUT OF SEGMENTS





Overhead Line = Solid
Reconductored Line = Dashed
Underground Line = Dashed Labeled Underground
Add-on Line = Dash Dot Dash Dot

Project Substations/Switchyards

- Proposed
- Existing

AC Transmission Upgrades Proceeding
Case 13-E-0488

Recommended Transmission Lines
DPS Trial Staff

September 22, 2015

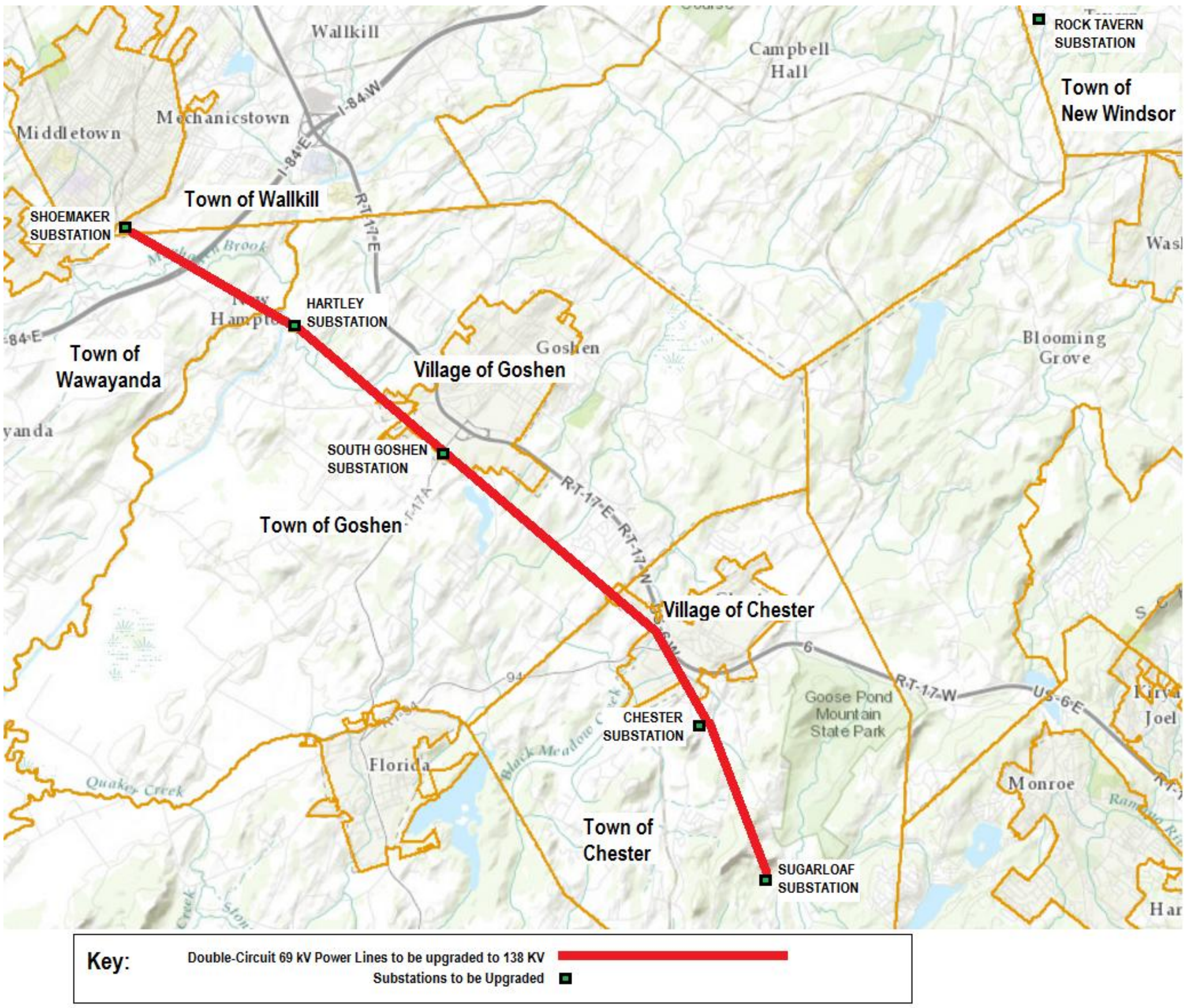
NEW YORK STATE OF OPPORTUNITY. Department of Public Service

APPENDIX 6

Possible Environmental Impacts of Sugarloaf-Shoemaker Segment

The following constitutes Trial Staff's initial examination of the possible environmental impacts associated with the Sugarloaf-Shoemaker upgrades that are required, along with a graphic representation of the segment at issue.

Segment Map



The following environmental analysis is not a final analysis, and Trial Staff will reserve final assessment for a potential Article VII proceeding in the future.

Sugarloaf-Shoemaker ROW – Upgrade 69 KV TO 138 KV: Environmental Impacts	
Municipalities	Facility located in Town and Village of Goshen and Chester, Town of Wawayanda, Town of Wallkill: four towns, two villages
Length of Route	(All existing ROW): 11.97 miles
Residences Within 250 feet of Facilities	+/- 113 residences(plus 20 business, industrial or warehouse buildings).
Agricultural Districts Crossed	4.23 miles
NWI & DEC Wetlands Length and Acreage Crossed by ROW	DEC wetlands = 7791 ft. or 1.47 miles, 17.8 acres NWI wetlands = 10,720 ft. or 2.03 miles, 24.6 acres
FEMA 100-yr Floodplains	Distance crossed = 2.44 miles
NYS Regulated Streams	1 class B, and 14 class C streams
OPRHP – NRHP Resources Within or Abutting 1-mile Corridor	12 locations
Public Surface Water Supply	Goshen reservoir 250+ feet away
Natural Heritage Habitat Areas	Known RT&E species habitats

This would represent a Low or Medium ranking based on Trial Staff’s criteria contained in this report.

TABLE 1

Table 1 Comparative Environmental Parameters

Scenario	Description	OVERALL RANK	Length of Route(s)		New ROW			Expansion of Existing ROW			Total New ROW and Expanded ROW			Structures [1]
			Miles	Rank	Miles	Acres	Rank	Miles	Acres	Rank	Miles	Acres	Rank	
1 - NAT Edic - Fraser w/series comp at Edic; New Scotland - Leeds - Pleasant Valley	**ED-FR**: Approx 80 miles: 72 miles adjacent to existing 345 kV ROW; 8 miles new ROW. 80' width where adjacent ROW; 100' width where new ROW. **NS-LD-PV**: Approx 65 miles: 55 miles adjacent to existing 345 kV ROW; 10 miles new ROW. 80' width where adjacent ROW; 100' width where new ROW.	high	145.0	high	18.0	218.2	high	127.0	1231.5	high	145.0	1449.7	high	Vertical Monopole/ Lattice Tower
2 - NAT Edic - Fraser w/series comp at Edic; New Scotland - Leeds - Pleasant Valley Alt 1	**ED-FR:** Approx 80 miles: 72 miles adjacent to existing 345 kV ROW; 8 miles new ROW. 80' width where adjacent ROW; 100' width where new ROW. **NS-LD-PV Alt 1**: Approx 77 miles: 55 miles entirely within existing I-87 ROW; 14 miles of new 100' ROW; 8 miles of 80' expanded ROW adjacent to existing CSX ROW.	high	157.0	high	22.0	266.7	high	80.0	775.8	high	102.0	1042.5	high	Vertical Monopole/ Lattice Tower
3 - NAT Edic - Fraser w/series comp at Edic; New Scotland - Leeds - Pleasant Valley; series comp on Fraser - Gilboa 345 kV; loop existing Marcy - Coopers Corners to Fraser	**ED-FR**: Approx 80 miles: 72 miles adjacent to existing 345 kV ROW; 8 miles new ROW. 80' width where adjacent ROW; 100' width where new ROW. **NS-LD-PV**: Approx 65 miles: 55 miles adjacent to existing 345 kV ROW; 10 miles new ROW. 80' width where adjacent ROW; 100' width where new ROW.	high	145.0	high	18.0	218.0	high	127.0	1232.0	high	145.0	1450.0	high	Vertical Monopole/ Lattice Tower
4 - NAT Edic - Fraser w/series comp at Edic; New Scotland - Pleasant Valley Alt 2; series comp on Fraser - Gilboa 345 kV; loop existing Marcy - Coopers Corners to Fraser; series comp on Marcy - New Scotland 345 kV; series comp on Edic - New Scotland 345 kV	**ED-FR**: Approx 80 miles: 72 miles adjacent to existing 345 kV ROW; 8 miles new ROW. 80' width where adjacent ROW; 100' width where new ROW. **NS-PV Alt 2**: Approx 62 miles; 8 miles of 80' expanded ROW adjacent to existing CSX ROW; 54 miles entirely within an existing 115 kV ROW.	high	142.0	med	8.0	96.7	high	80.0	775.8	high	88.0	872.4	high	Vertical Monopole/H-Frame
5 - NAT[2] Edic - Fraser w/series comp at Edic; New Scotland - Knickerbocker - Pleasant Valley Alt 2; series comp on Fraser - Gilboa 345 kV; loop existing Marcy - Coopers Corners to Fraser; Edic - Princetown - Knickerbocker (as proposed by others)	**ED-FR**: Approx 80 miles: 72 miles adjacent to existing 345 kV ROW; 8 miles new ROW. 80' width where adjacent ROW; 100' width where new ROW. **NS-KN-PV Alt 2**: Approx 62 miles; 8 miles of 80' expanded ROW adjacent to existing CSX ROW; 54 miles entirely within an existing 115 kV ROW. New switchyard constructed at Knickerbocker.	high	142.0	med	8.0	96.7	high	80.0	775.8	high	88.0	872.4	high	Vertical Monopole/H-Frame
6 - NYTO Knickerbocker to Pleasant Valley	**KN-PV:** Removal of existing 1 or 2 115 kV double circuit lines and construction of new 115/345 kV double circuit monopole structure line.	low	54.2	low	0	0	low	0	0	low	0	0	low	Steel Monopoles/ Replacement of some lattice towers
7 - NYTO Leeds to Pleasant Valley (Reconductor)	**LD-PV(R)**: Reconductoring of the two existing 345 kV lattice structure lines and replacement of certain structures within an existing ROW.	low	39.8	low	0	0	low	0	0	low	0	0	low	Existing Steel Lattice with Replacement of Certain Structures

Scenario	Major River Corridors				New Substations or Switchyards	Substations or Switchyards with Expanded Footprint	Land Acquisition Needed for Substations or Switchyards		Counties	Towns, Villages & Cities
	Mohawk River/Erie Canalway/Susquehanna River	Rank	Hudson River	Rank	#	#	Y/N	Rank	#	#
1 - NAT	Overhead Crossing on New ROW with Forest Clearing at Erie Canalway Overhead Crossing at Susquehanna River	high	Overhead Crossing Adjacent ROW; Lattice Structures; Athens LWRP; SASS Views	high	0	1	No	low	8	29
2 - NAT	Overhead Crossing on New ROW with Forest Clearing at Erie Canalway Overhead Crossing at Susquehanna River	high	Overhead Crossing New ROW; Monopole/ Forest Clearing; SASS; Lloyd LWRP	high	0	1	No	low	8	32
3 - NAT	Overhead Crossing on New ROW with Forest Clearing at Erie Canalway Overhead Crossing at Susquehanna River	high	Overhead Crossing Adjacent ROW; Lattice Structures; Athens LWRP/ SASS Views	high	0	2	No	low	8	29
4 - NAT	Overhead Crossing on New ROW with Forest Clearing at Erie Canalway Overhead Crossing at Susquehanna River	high	Overhead Crossing Adjacent ROW; Schodack LWRP; SASS Views	high	0	3-4[3]	No	low	8	32
5 - NAT[2]	Overhead Crossing on New ROW with Forest Clearing at Erie Canalway Overhead Crossing at Susquehanna River	high	Overhead Crossing Adjacent ROW; Schodack LWRP; SASS Views	high	1	2-3[3]	No	low	8	32
6 - NYTO	N/A	low	No Crossing; SASS Area	low	1	2	No	low	3	11
7 - NYTO	N/A	low	Replace River Crossing; Athens LWRP	med	0	0	No	low	3	8

Scenario	S-NRHP Crossed or Within 1 Mile		Distance Crossing NWI Wetlands		Regulated Streams Crossed by ROW		Distance Crossing 100-YR Floodplains		Length of ROW in Ag Districts		Forested Wetlands		Total Forest		Residences Within 1-250 Feet		Overall Noise Impact	Visual Assessment
	#	Rank	Miles	Rank	#	Rank	Miles	Rank	Miles	Rank	Acres	Rank	Acres	Rank	#	Rank	Rank	Rank
1 - NAT	35	med	6.2	high	217	high	9.3	high	41.8	high	84.1	med	866.7	med	98	med	med	high
2 - NAT	48	med	5.1	med	167	med	9.5	high	28.1	med	82.9	med	804.0	med	232	med	med	high
3 - NAT	35	med	6.2	high	217	high	9.3	high	41.8	high	84.1	med	866.7	med	98	med	med	high
4 - NAT	36	med	4.8	med	183	high	6.8	med	52.5	high	58.0	low	721.5	med	113	med	med	high
5 - NAT[2]	36	med	4.8	med	183	high	6.8	med	52.5	high	58.0	low	721.5	med	113	med	med	high
6 - NYTO	33	med	2.8	low	59	low	2.09	low	27.9	med	44.3	low	257.8	low	121	med	low	med
7 - NYTO	20	low	3.8	med	28	low	3.46	low	9.72	low	83.2	med	182.4	low	33	low	low	low

[1] - For each NAT scenario, the ED-FR structures will be vertical monopole configuration where parallel to existing ROW and delta formation where not parallel to existing ROW.

[2] - NAT has not provided details regarding the proposed ED-PR-KN (as proposed by others) component of Scenario 5. Therefore Staff omitted this component from its environmental evaluation of Scenario 5.

[3] - NAT states that modifications to existing Churchtown 115 kV substation will be required. However, NAT does not provide details of the modifications or indicate whether modifications will require expanded footprint.

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Table 1 Comparative Environmental Parameters

Scenario	Description	OVERALL RANK	Length of Route(s)		New ROW			Expansion of Existing ROW			Total New ROW and Expanded ROW			Structures	Major River Corridors				New Substations or Switchyards	Substations or Switchyards with Expanded Footprint	Land Acquisition Needed for Substations or Switchyards	
			Miles	Rank	Miles	Acres	Rank	Miles	Acres	Rank	Miles	Acres	Rank		Mohawk River/Erie Canalway/Susquehanna River	Rank	Hudson River	Rank	#	#	Y/N	Rank
8 - NYTO Hurley Avenue Phase Angle Regulators (PARs)	**HA:** Installation of three 575 MW PARs, two 135 MVA switched shunt capacitors and three 345 kV circuit breakers at the Hurley Avenue Substation.	low	0	low	0	0	low	0	0	low	0	0	low	N/A	N/A	low	N/A	low	0	1	No	low
9 - NYTO New Scotland to Leeds (Reconductor) and Leeds to Pleasant Valley	**NS-LD(R):** Reconductoring of two existing 345 kV lattice structure lines and replacement of certain structures. **LD-PV:** Removal of the existing 115 kV double-circuit lattice structure lines and the construction of a new monopole double-circuit 115/345 kV line; removal of existing 1 or 2 115 kV double circuit lines; construction of a new 115/345 kV double circuit monopole structure line.	low	67.1	low	0	0	low	0	0	low	0	0	low	Steel Monopoles/ Replacement of some lattice towers	N/A	low	Replace Existing Overhead Crossing; Athens LWRP; SASS Views	med	0	3	No	low
10 - NYTO Oakdale to Fraser; Edic to New Scotland and Knickerbocker to Pleasant Valley (Enhanced Oct. 2013 Project)	**O-FR:** Construction of 57.7 mile 345 kV circuit within existing ROW supported by steel monopoles. **ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **KN-PV:**Removal of existing 1 or 2 115 kV double circuit lines and construction of new 115/345 kV double circuit monopole structure line.	high	203.4	high	0	0	low	0	0	low	0	0	low	H-Frame and Monopoles	Replace Overhead Crossing No clearing at Erie Canalway Overhead Crossing at Susquehanna River	med	No Crossing; ROW in SASS	med	1	6	No	low
11 - NYTO Edic to New Scotland and Knickerbocker to Pleasant Valley	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **KN-PV:** Removal of existing 1 or 2 115 kV double circuit lines and construction of new 115/345 kV double circuit monopole structure line.	med	145.6	high	0	0	low	0	0	low	0	0	low	Steel Monopole/H-Frame	Replace Overhead Crossing No clearing at Erie Canalway	low	No Crossing; ROW in SASS	med	1	4	No	low
12 - NYTO Edic to New Scotland and New Scotland to Leeds to Pleasant Valley (Reconductor)	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **NS-LD-PV(R):** Reconductoring of two existing 345 kV lattice structure lines and replacement of certain structures.	med	157.1	high	0	0	low	0	0	low	0	0	low	Steel Monopoles/ Replacement of some H-frame & lattice towers	Replace Overhead Crossing No clearing at Erie Canalway	low	Replace Existing Overhead Crossing; Athens LWRP; SASS Views	med	0	4	No	low
13 - NYTO Edic to New Scotland and Hurley Avenue PARs	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **HA:** Installation of three 575 MW PARs, two 135 MVA switched shunt capacitors and three 345 kV circuit breakers at the Hurley Avenue Substation.	med	91.4	low	0	0	low	0	0	low	0	0	low	H-Frame and Steel Monopoles	Replace Overhead Crossing No clearing at Erie Canalway	low	N/A	low	0	3	No	low
14 - NYTO Edic to New Scotland and New Scotland to Leeds (Reconductor) and Leeds to Pleasant Valley	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **NS-LD(R):** Reconductoring of two existing 345 kV lattice structure lines and replacement of certain structures. **LD-PV:** Removal of the existing 115 kV double-circuit lattice structure lines and the construction of a new monopole double-circuit 115/345 kV line; removal of existing 1 or 2 115 kV double circuit lines; construction of a new 115/345 kV double circuit monopole structure line.	med	158.5	high	0	0	low	0	0	low	0	0	low	Steel Monopoles/ Replacement of some H-frame & lattice towers	Replace Overhead Crossing No clearing at Erie Canalway	low	Existing Overhead Crossing; replace lattice with monopoles, Athens LWRP; SASS Views	med	0	2	No	low

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<u>Table 1 Comparative Environmental Parameters</u>

Scenario	Description	OVERALL RANK	Counties	Towns, Villages & Cities	S-NRHP Crossed or Within 1 Mile		Distance Crossing NWI Wetlands		Regulated Streams Crossed by ROW		Distance Crossing 100-YR Floodplains		Length of ROW in Ag Districts		Forested Wetlands		Total Forest		Residences Within 1-250 Feet		Overall Noise Impact	Visual Assessment
			#	#	#	Rank	Miles	Rank	#	Rank	Miles	Rank	Miles	Rank	Acres	Rank	Acres	Rank	#	Rank	Rank	Rank
8 - NYTO Hurley Avenue Phase Angle Regulators (PARs)	**HA:** Installation of three 575 MW PARs, two 135 MVA switched shunt capacitors and three 345 kV circuit breakers at the Hurley Avenue Substation.	low	1	1	0	low	0	low	0	low	0	low	0	low	0	low	0.21	low	0	low	low	low
9 - NYTO New Scotland to Leeds (Reconductor) and Leeds to Pleasant Valley	**NS-LD(R):** Reconductoring of two existing 345 kV lattice structure lines and replacement of certain structures. **LD-PV:** Removal of the existing 115 kV double-circuit lattice structure lines and the construction of a new monopole double-circuit 115/345 kV line; removal of existing 1 or 2 115 kV double circuit lines; construction of a new 115/345 kV double circuit monopole structure line.	low	3	12	32	med	4.6	med	60	low	5.2	med	8.9	low	149.9	med	453.0	med	137	med	low	low
10 - NYTO Oakdale to Fraser; Edic to New Scotland and Knickerbocker to Pleasant Valley (Enhanced Oct. 2013 Project)	**O-FR:** Construction of 57.7 mile 345 kV circuit within existing ROW supported by steel monopoles. **ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **KN-PV:**Removal of existing 1 or 2 115 kV double circuit lines and construction of new 115/345 kV double circuit monopole structure line.	high	11	44	50	high	6.1	high	242	high	7.4	med	55.5	high	268.1	high	2966.0	high	169	med	high	med
11 - NYTO Edic to New Scotland and Knickerbocker to Pleasant Valley	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **KN-PV:** Removal of existing 1 or 2 115 kV double circuit lines and construction of new 115/345 kV double circuit monopole structure line.	med	8	30	48	med	5.3	med	169	med	5.2	med	28.1	med	258.2	high	1005.0	high	156	med	med	med
12 - NYTO Edic to New Scotland and New Scotland to Leeds to Pleasant Valley (Reconductor)	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **NS-LD-PV(R):** Reconductoring of two existing 345 kV lattice structure lines and replacement of certain structures.	med	8	31	53	high	7.8	high	160	med	5.0	med	9.9	low	322.7	high	989.8	high	171	med	high	low
13 - NYTO Edic to New Scotland and Hurley Avenue PARs	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **HA:** Installation of three 575 MW PARs, two 135 MVA switched shunt capacitors and three 345 kV circuit breakers at the Hurley Avenue Substation.	med	6	20	15	low	2.5	low	111	low	3.1	low	0.2	low	213.9	high	747.7	med	35	low	low	med
14 - NYTO Edic to New Scotland and New Scotland to Leeds (Reconductor) and Leeds to Pleasant Valley	**ED-NS:** For first 12+ miles, remove of one set of 230 kV wires and insulators from each of the two existing 230/345 kV double-circuit monopole structures and installation of one set of 345 kV wires and insulators to one of them; for the next 54+ miles replace two existing 230 kV H-frame structure lines with one 345 kV compact monopole structure line. For the Princetown to Rotterdam segment replace two existing 230 kV H-frame structure lines with two 345 kV compact monopole structure lines. **NS-LD(R):** Reconductoring of two existing 345 kV lattice structure lines and replacement of certain structures. **LD-PV:** Removal of the existing 115 kV double-circuit lattice structure lines and the construction of a new monopole double-circuit 115/345 kV line; removal of existing 1 or 2 115 kV double circuit lines; construction of a new 115/345 kV double circuit monopole structure line.	med	8	32	47	med	7.1	high	170	med	7.7	med	9.0	low	363.8	high	1198.0	high	171	med	high	med

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Table 1 Comparative Environmental Parameters

Scenario	Description	OVERALL RANK	Length of Route(s)		New ROW			Expansion of Existing ROW			Total New ROW and Expanded ROW			Structures	Major River Corridors				New Substations or Switchyards	Substations or Switchyards with Expanded Footprint	Land Acquisition Needed for Substations or Switchyards	
			Miles	Rank	Miles	Acres	Rank	Miles	Acres	Rank	Miles	Acres	Rank		Mohawk River/Erie Canalway/Susquehanna River	Rank	Hudson River	Rank	#	#	Y/N	Rank
15 - NextEra Edic -Leeds - Pleasant Valley via Thruway and other ROW	**Thruway ED-LD-PV:** 345 kV line approximately 180 miles in length; adjacent to existing NYS Thruway ROW for approximately 163 miles requiring expansion of existing NYS Thruway ROW 30-35 feet wide; where not adjacent to NYS Thruway ROW, facility will be entirely within or will require expansion of existing electric transmission ROW and short segments of new ROW.	high	179.0	high	8.5	128	high	166.5	1528	high	175.0	1656.0	high	Spun Concrete Monopoles	New Overhead Adjacent to Existing; Forest Clearing near Erie Canalway	high	River Crossing either Overhead, HDD or bridge, Lloyd LWRP; SASS	high	0	3	No	low
16 - NextEra Marcy Southern Route 1: Marcy - Princetown; Princetown - Rotterdam; Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Marcy Southern 1 (M-PR, PR-R, GB-KN, KN-CH-PV):** Entirely within existing ROW; new PR Substation; **M-PR:** Replace existing two 230 kV lines with one 345 kV circuit; Approximately 68 miles; 56 miles new 345 kV line; 12 miles 345 kV reconductoring; **PR-R:** Approximately 5 miles; rebuild two existing 230 kV parallel circuits. **Knickerbocker Route:** Entirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	med	135.0	med	0	0	low	0	0	low	0.0	0.0	low	Spun Concrete Monopoles	Replace Overhead Crossing; Forest Clearing near Erie Canalway	med	No Crossing; Line in SASS	low	3	4	yes	high
17 - NextEra Marcy Southern Route 2: Marcy - New Princetown; Princetown - Rotterdam (rebuild); Princetown - New Scotland - Knickerbocker; Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Marcy Southern 2** Entirely within existing ROW; replace existing M-NS-KN 765 kV facility; new PR Substation; **M-PR:** Replace existing two 230 kV lines with one 345 kV circuit; Approximately 68 miles; 56 miles new 345 kV line; 12 miles 345 kV reconductoring; **PR-R:** Approximately 5 miles; rebuild two existing 230 kV parallel circuits; **PR-NS:** Approximately 20 miles; two parallel 345 kV transmission lines, partial rebuild of existing M-NS 345 kV line and addition of one new PR-KN 345 kV line; **NS-KN:** Approximately 13 miles; two parallel 345 kV transmission lines; rebuild existing 345 kV NS-Alps line and new PR-KN 345 kV line. **Knickerbocker Route: E**ntirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	high	167.0	high	0	0	low	0	0	low	0.0	0.0	low	Spun Concrete Monopoles	Replace Overhead Crossing; Forest Clearing near Erie Canalway	med	1-HDD, or 1-rebuild New Scotland Alps or Bridge Attachment, Schodack LWRP; Line in SASS	high	3	6	yes	high
18 - NextEra Marcy Northern Route: Marcy - Orchard Hill - New Scotland; Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Marcy Northern:** Approximately 84.5 miles; new OH Switchyard; **MA-OH:** New 345 kV transmission line on expanded ROW 110 feet wide parallel to existing 345 kV facility; **OH-NS:** Approximately 0.5 miles; two parallel 345-kV lines on new ROW. **Knickerbocker Route: E**ntirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	high	179.0	high	0.5	3.7	med	84.0	1120.0	high	84.5	1123.7	high	Spun Concrete Monopoles	New Overhead Adjacent to Existing; Forest Clearing near Erie Canalway	high	No River Crossing; Line in SASS	low	3	5	yes	high
19A - NextEra Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Knickerbocker Route:** Entirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	med	63.0	low	0	0	low	0	0	low	0.0	0.0	low	Spun Concrete Monopoles	N/A	low	No River Crossing; Line in SASS	low	2	3	yes	high
19B - NextEra Oakdale - Fraser	**O-FR:** Construction of a 57.7 mile 345 kV circuit on concrete monopoles entirely within an existing ROW .	med	57.7	low	0	0	low	0	0	low	0.0	0.0	low	Spun Concrete Monopoles	Overhead Crossing at Susquehanna River	med	N/A	low	0	2	No	low
19C* - NextEra/NYISO Knickerbocker to Pleasant Valley	**KN-PV:** Entirely within existing ROW; new KN Substation; **KN-CH:** Replace two existing 115 kV lines with one 115/345 kV double circuit facility; approximately 22.2 miles; **CH-KN:** New 115/345 kV double circuit facility; approximately 31.1 miles.	low	54.2	low	0	0	low	0	0	low	0	0	low	Spun Concrete Monopoles	N/A	low	No River Crossing; Line in SASS	low	2	2	No	low
20 - Boundless Leeds - Hurley Avenue; Athens Generating - Leeds - Pleasant Valley; CPV Tap to Rock Tavern; Roseton - East Fishkill	**LD-HA(R), Athens Generating-LD-PV(R), CPV VALLEY-RT(R):** Reconductoring of approximately 83 miles of existing 345 kV circuits on existing structures using ACCC or ACSR conductor cables; installation of a total of 40% series compensation equipment at the Hurley Ave Substation. **RS-EF:** Installation of 2 new underground 345 kV lines from RS to EF; approximaetly 8 miles.	med	92.0	low	0	0	low	8.1	20.0	low	8.1	20.0	low	Monopoles/H-frame/ Lattice/ Underground	N/A	low	**RS-EF:** HDD Crossing; **LD-PV:** Replace River Crossing, Athens LWRP	med	0	7	No	low
21 - Boundless Leeds - Hurley Avenue; CPV Tap - Rock Tavern; Roseton - East Fishkill	**LD-HA(R), CPV-RT(R):** Reconductoring of approximately 44 miles of existing 345 kV circuits on existing structures using ACCC or ACSR conductor cables; installation of a total of 40% series compensation equipment at the Hurley Ave Substation. **RS-EF:** Installation of 2 new underground 345 kV lines from RS to EF; approximaetly 8 miles.	low	52.0	low	0	0	low	8.1	20.0	low	8.1	20.0	low	Monopoles/H-frame/ Lattice/ Underground	N/A	low	**RS-EF:** HDD Crossing	med	0	6	no	low

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* - Data for acreage and miles was taken from NYTO Scenario 6

** - Residence proximity data submitted by Boundless represents distance from the edge of ROW

<u>Table 1 Comparative Environmental Parameters</u>

Scenario	Description	OVERALL RANK	Counties	Towns, Villages & Cities	S-NRHP Crossed or Within 1 Mile		Distance Crossing NWI Wetlands		Regulated Streams Crossed by ROW		Distance Crossing 100-YR Floodplains		Length of ROW in Ag Districts		Forested Wetlands		Total Forest		Residences Within 1-250 Feet		Overall Noise Impact	Visual Assessment
			#	#	#	Rank	Miles	Rank	#	Rank	Miles	Rank	Miles	Rank	Acres	Rank	Acres	Rank	#	Rank	Rank	Rank
15 - NextEra Edic -Leeds - Pleasant Valley via Thruway and other ROW	**Thruway ED-LD-PV:** 345 kV line approximately 180 miles in length; adjacent to existing NYS Thruway ROW for approximately 163 miles requiring expansion of existing NYS Thruway ROW 30-35 feet wide; where not adjacent to NYS Thruway ROW, facility will be entirely within or will require expansion of existing electric transmission ROW and short segments of new ROW.	high	8	29	140	high	3.1	low	193	high	18.9	high	6.7	low	35.0	low	135.2	low	750	high	med	high
16 - NextEra Marcy Southern Route 1: Marcy - Princetown; Princetown - Rotterdam; Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Marcy Southern 1 (M-PR, PR-R, GB-KN, KN-CH-PV):** Entirely within existing ROW; new PR Substation; **M-PR:** Replace existing two 230 kV lines with one 345 kV circuit; Approximately 68 miles; 56 miles new 345 kV line; 12 miles 345 kV reconductoring; **PR-R:** Approximately 5 miles; rebuild two existing 230 kV parallel circuits. **Knickerbocker Route:** Entirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	med	7	26	21	low	3.1	low	177	high	2.6	low	6.0	low	44.5	low	459.2	med	221	med	high	med
17 - NextEra Marcy Southern Route 2: Marcy - New Princetown; Princetown - Rotterdam (rebuild); Princetown - New Scotland - Knickerbocker; Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Marcy Southern 2** Entirely within existing ROW; replace existing M-NS-KN 765 kV facility; new PR Substation; **M-PR:** Replace existing two 230 kV lines with one 345 kV circuit; Approximately 68 miles; 56 miles new 345 kV line; 12 miles 345 kV reconductoring; **PR-R:** Approximately 5 miles; rebuild two existing 230 kV parallel circuits; **PR-NS:** Approximately 20 miles; two parallel 345 kV transmission lines, partial rebuild of existing M-NS 345 kV line and addition of one new PR-KN 345 kV line; **NS-KN:** Approximately 13 miles; two parallel 345 kV transmission lines; rebuild existing 345 kV NS-Alps line and new PR-KN 345 kV line. **Knickerbocker Route: E**ntirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	high	8	32	28	med	5.6	high	218	high	8.8	high	7.5	low	152.0	med	809.2	med	292	high	high	med
18 - NextEra Marcy Northern Route: Marcy - Orchard Hill - New Scotland; Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Marcy Northern:** Approximately 84.5 miles; new OH Switchyard; **MA-OH:** New 345 kV transmission line on expanded ROW 110 feet wide parallel to existing 345 kV facility; **OH-NS:** Approximately 0.5 miles; two parallel 345-kV lines on new ROW. **Knickerbocker Route: E**ntirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	high	7	17	22	med	4.9	med	206	high	3.9	low	35.1	high	103.0	med	666.2	med	260	high	high	high
19A - NextEra Knickerbocker Route: Greenbush - Knickerbocker - Churchtown - Pleasant Valley	**Knickerbocker Route:** Entirely within existing ROW; new KN Switchyard; **GB-KN:** New 115 kV facility approximately 8 miles long; **KN-CH-PV:** Replace existing KN-PV double circuit 115 kV lines; new 345/115 kV double cirucit transmission line approximately 22 miles long KN-CH; new 345 kV transmission line approximately 32 miles long CH-PV.	med	3	11	13	low	2.2	low	89	low	2.1	low	31.0	med	31.7	low	211.5	low	182	med	med	low
19B - NextEra Oakdale - Fraser	**O-FR:** Construction of a 57.7 mile 345 kV circuit on concrete monopoles entirely within an existing ROW .	med	3	14	1	low	0.8	low	64	low	2.2	low	27.1	med	8.7	low	347.8	low	33	low	low	med
19C* - NextEra/NYISO Knickerbocker to Pleasant Valley	**KN-PV:** Entirely within existing ROW; new KN Substation; **KN-CH:** Replace two existing 115 kV lines with one 115/345 kV double circuit facility; approximately 22.2 miles; **CH-KN:** New 115/345 kV double circuit facility; approximately 31.1 miles.	low	3	11	13	low	2.8	low	59	low	2.1	low	27.9	med	44.3	low	257.8	low	121	med	low	low
20 - Boundless Leeds - Hurley Avenue; Athens Generating - Leeds - Pleasant Valley; CPV Tap to Rock Tavern; Roseton - East Fishkill	**LD-HA(R), Athens Generating-LD-PV(R), CPV VALLEY-RT(R):** Reconductoring of approximately 83 miles of existing 345 kV circuits on existing structures using ACCC or ACSR conductor cables; installation of a total of 40% series compensation equipment at the Hurley Ave Substation. **RS-EF:** Installation of 2 new underground 345 kV lines from RS to EF; approximaetly 8 miles.	med	5	23	32	med	7.2	high	127	med	8.4	high	28.0	med	68.4	med	312.0	low	272*	high	med	low
21 - Boundless Leeds - Hurley Avenue; CPV Tap - Rock Tavern; Roseton - East Fishkill	**LD-HA(R), CPV-RT(R):** Reconductoring of approximately 44 miles of existing 345 kV circuits on existing structures using ACCC or ACSR conductor cables; installation of a total of 40% series compensation equipment at the Hurley Ave Substation. **RS-EF:** Installation of 2 new underground 345 kV lines from RS to EF; approximaetly 8 miles.	low	4	16	13	low	3.4	low	91	low	5.9	med	14.0	low	29.7	low	275.5	low	176*	med	low	low

LWRP - Local Waterfront Revitalization Program

SASS - Scenic Area of State-wide Significance

* - Data for acreage and miles was taken from NYTO Scenario 6

** - Residence proximity data submitted by Boundless represents distance from the edge of ROW

TABLE 2

Table 2 - Comparative Ranking Criteria

Physical or Environmental Parameters	Low	Medium	High
Length of Route(s) (miles)	0-94.5	94.6-144.6	144.7+
New ROW (miles / acres)	0-0.4-7.1/ 0-4.9	0.4-7.2 / 5.0-88.4	7.3/88.5
Expansion of Existing ROW (miles / acres)	0-8.4 / 0-81.2	8.5-60.7 / 81.3-598.6	60.8+ / 598.7+
Total New ROW and Expanded ROW (miles / acres)	0-9.4 / 0-94.1	9.5-67.3 / 94.2-679.2	67.4+ / 679.3+
S-NRHP Crossed or Within 1 Mile	0-21	22-48	49+
Distance Crossing NWI Wetlands (miles)	0-3.5	3.6-5.4	5.5+
Regulated Streams Crossed by ROW	0-113	114-176	177+
Distance Crossing 100-YR Floodplains (miles)	0-4.3	4.4-8.2	8.3+
Length of ROW in Ag. Districts (miles)	0-16.7	16.8-33.2	33.3+
Forested Wetlands (acres)	0-67.5	67.6-167.8	167.9+
Total Forest (acres)	0-402.7	402.8-984.0	984.1+
Residences Within 1-250 Feet	0-93	94-243	244+

NOTES:

1. The rankings were established by calculating the average (mean) for each measurable factor. The medium rank ranges represent half of a population standard deviation on either side of the calculated mean. Low rankings were assigned to values less than the medium rank range and high rankings were assigned to values greater than the medium

2. The standard deviation applied in Table 2 of the Interim Report was a sample standard deviation. Staff changed the standard deviation calculation approach to a population standard deviation in order to more accurately determine the medium ranking ranges for each category with a data set that represents the entire data population.