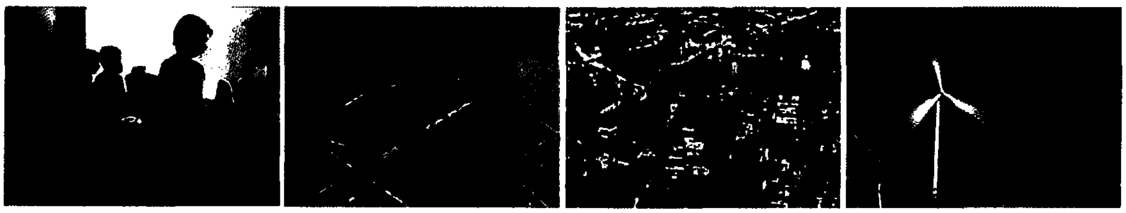
2014 Reliability Needs Assessment



New York Independent System Operator

FINAL REPORT

September 16, 2014

Caution and Disclaimer

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Executive Summary

The 2014 Reliability Needs Assessment (RNA) assesses resource adequacy and both transmission security and adequacy of the New York Control Area (NYCA) bulk power transmission system from year 2015 through 2024, the study period of this RNA. The 2014 RNA identifies transmission security needs in portions of the bulk power transmission system, and a NYCA LOLE violation due to inadequate resource capacity located in Southeast New York (SENY).

The NYISO finds transmission security violations beginning in 2015, some of which are similar to those found in the 2012 RNA. The NYISO also identifies resource adequacy violations, which begin in 2019 and increase through 2024.

For transmission security, there are four primary regions with reliability needs: Rochester, Western & Central New York, Capital Region, and Lower Hudson Valley & New York City. These reliability needs are generally driven by recent and proposed generator retirements or mothballing combined with load growth. The New York transmission owners have developed plans through their respective local transmission planning processes to construct transmission projects to meet not only the needs identified in the previous RNA, but also any additional needs occurring since then and prior to this RNA. These transmission projects, subject to inclusion rules, have been modeled in the 2014 RNA base case. Reliability needs identified in this report exist despite the inclusion of the transmission projects in the base case, or exist until certain projects are completed. The transmission security needs in the Buffalo and Binghamton areas are influenced by whether the fuel conversion project can be completed for the Dunkirk Plant for it to return to service by 2016. As a result, this project was addressed as a sensitivity and the impact of the results are noted with the base case reliability needs.

While resource adequacy violations continue to be identified in SENY, the 2014 RNA is projecting the need year to be 2019, one year before the need year identified in the 2012 RNA. The most significant difference between the 2012 RNA and the 2014 RNA is the decrease of the NYCA capacity margin (the total capacity less the peak load forecast).

For summer 2014 resource adequacy, the existing capacity provides about a 122.7% Installed Capacity Reserve to meet the summer 2014 Installed Reserve Margin requirement of 117.0%. The capacity margin decreases throughout the study period, but more rapidly in the outer years due to load growth. The NYISO calculated the difference in the capacity margin between the 2012 RNA and the 2014 RNA in the need year of 2019 and determined a net decrease of 2,100 MW. The difference breaks down as follows:

1. The NYCA capacity resources are 874 MW less for 2019 (724 MW upstate and 150 MW in SENY);
2. The NYCA baseline load forecast is 250 MW higher for 2019 (497 MW higher upstate and 247 MW lower in SENY); and
3. The NYCA Special Case Resources (SCRs) projection is 976 MW less for 2019 (685 MW upstate and 291 MW in SENY).

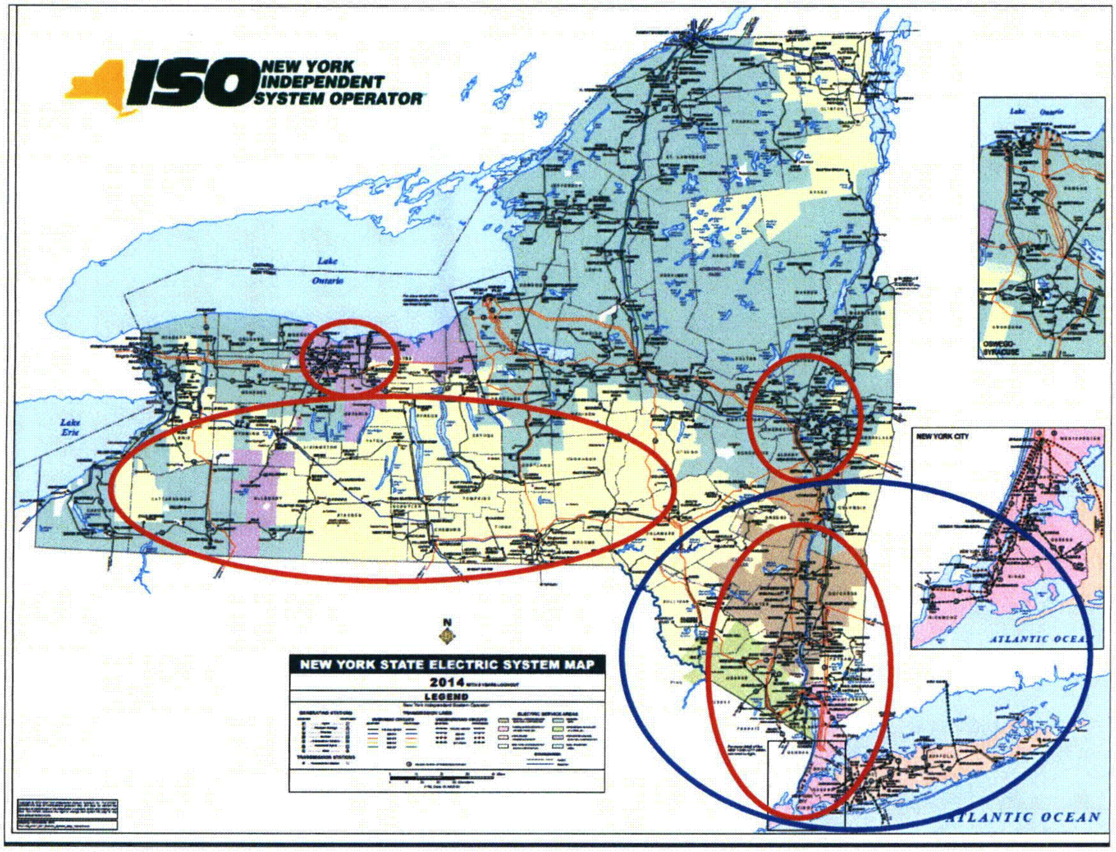
The reliability needs identified in the 2014 RNA are summarized in Table 1 below, and the approximate locations of the regions are marked on Figure 1.

Table 1: Reliability Needs identified in 2014 RNA

Year of Need	Transmission Security Violations (Area/Load Zone/Transmission Owner)	Resource Adequacy (LOLE)
2015	Rochester Area in Genesee (Zone B), owned by RG&E	No violation
	Binghamton Area in Central (Zone C), owned by NYSEG*	
	Syracuse Area in Central (Zone C), owned by N. Grid	
	Utica Area in Mohawk Valley (Zone E), owned by N. Grid	
	Albany Area in Capital (Zone F), owned by N. Grid	
2016	No additional violations	
2017	Rochester Area issues mitigated	
	Additional Syracuse Area in Central (Zone C), owned by N. Grid	
	Additional Utica Area in Mohawk Valley (Zone E), owned by N. Grid*	
	Binghamton Area voltage in Central (Zone C), owned by NYSEG	
2018	Buffalo Area in Dysinger (Zone A), owned by N. Grid*	
2019	No additional violations	Violation (LOLE = 0.11)
2020	Additional Binghamton Area in Central (Zone C), owned by NYSEG*	Violation (LOLE = 0.13)
2021	Additional Buffalo Area in West (Zone A), owned by N. Grid*	Violation (LOLE = 0.15)
2022	Additional Buffalo Area in West (Zone A), owned by N. Grid*	Violation (LOLE = 0.18)
	Transmission between Capital (Zone F) and Hudson Valley (Zone G), owned by N. Grid	
2023	No additional violations	Violation (LOLE = 0.22)
2024	No additional violations	Violation (LOLE = 0.26)

* Some violations would be resolved upon the return of the Dunkirk plant to service.

Figure 1: Approximate Locations of Reliability Needs



Note: The red circles indicate the areas where the load may be impacted by transmission security constraints, and the blue circle indicates the region with resource adequacy violations.

The NYISO expects existing and recent market rule changes to entice market participants to take actions that will help meet the resource adequacy needs in SENY, as identified by the 2012 RNA and the 2014 RNA. The resources needed downstream of the upstate New York to SENY interface is approximately 1,200 MW in 2024 (100 MW in 2019), which could be transmission or capacity resources. The new Zones G-J Locality will provide market signals for resources to provide service in this area. Capacity owners and developers are taking steps to return mothballed units to service, restore units to their full capability, or build new in the Zones G-J Locality. If some or all of these units return to service or are developed, the reliability need year would be postponed beyond 2019. In addition, other measures, such as the demand response, energy efficiency and CHP projects, would also postpone the reliability need year beyond 2019. New York State Public Service Commission is also promoting regulated transmission development to relieve the transmission constraints between upstate New York and SENY, which could also defer the need for additional resources. Potential solutions will be submitted for evaluation during the solutions phase of the Reliability Planning Process (RPP) and included in the upcoming 2014 Comprehensive Reliability Plan (CRP) if appropriate.

As a backstop to market-based solutions, the NYISO employs a process to define responsibility should the market fail to provide an adequate solution to an identified reliability need. Since there are transmission security violations in Zones A, B, C, E, and F within the study period, the transmission owners (TOs) in those zones (i.e., National Grid, RGE, and NYSEG) are responsible and will be tasked to develop detailed regulated backstop solutions for evaluation in the 2014 CRP.

Given the limited time between the identification of certain transmission security needs in this RNA report and their occurrence in 2015, the use of demand response and operating procedures, including those for emergency conditions, may be necessary to maintain reliability during peak load periods until permanent solutions can be put in place. Accordingly, the NYISO expects the TOs to present updates to their Local Transmission Owner Plans for these zones, including their proposed operating procedures pending completion of their permanent solutions, for review and acceptance by the NYISO and in the 2014 CRP.

The NYISO identified reliability needs for resource adequacy in SENY starting in the year 2019; therefore, the TOs in SENY (i.e., Orange & Rockland, Central Hudson, New York State Electric and Gas, Con Edison, and LIPA) are responsible to develop the regulated backstop solution(s). The study also identified a transmission security violation in 2022 on the Leeds-Pleasant Valley 345 kV circuit, and this circuit is the main constraint of the Upstate New York to Southeast New York (UPNY-SENY) interface identified in the resource adequacy analysis. Therefore, the violation could be resolved by solution(s) that respond to the resource adequacy deficiencies identified for 2019 – 2024.

If the resource adequacy solution is non-transmission, these reliability needs can only be most efficiently satisfied through the addition of compensatory megawatts in SENY because such resources need to be located below the UPNY-SENY interface constraint to be effective. Additions in Zones A through F could partially resolve these reliability needs. Potential solutions could include a combination of additional transfer capability by adding transmission facilities into SENY from outside those zones and/or resource additions at least some of which would be best located in SENY.

In addition, the 2014 RNA provides analysis of risks to the Bulk Power Transmission Facilities under certain sensitivities and scenarios to assist developers and stakeholders to propose market-based and regulated reliability solutions as well as policy makers to formulate state policy. The 2014 RNA analysis included a sensitivity of the Dunkirk Fuel conversion project, and scenarios to address recent experiences in the NYISO operations, which revealed potential future reliability risks caused particularly by generation retirements, fuel availability, or other factors that could limit energy production during the extreme winter weather. The findings under the sensitivity and scenario conditions are:

- *Dunkirk Fuel Conversion Project*: The availability of Dunkirk after the fuel conversion project in 2016 resolves thermal transmission security violations in the Buffalo and Binghamton areas, but does not resolve the resource adequacy needs identified in 2019 and thereafter.
- *High (econometric) Load Forecast*: Resource adequacy violations occur as soon as 2017.
- *Indian Point Energy Center Plant Retirement*: Reliability violations would occur in 2016 if the Indian Point Plant were to be retired at the latter of the two units' current license expiration dates in December 2015.
- *Zonal Capacity at Risk*: For year 2015, removal of up to 2,500 MW in Zones A through F, 650 MW in Zones G through I, 650 MW in Zone J, or 550 MW in Zone K would result in a NYCA resource adequacy violation.
- *Transmission Security under 90/10 Forecasted Load*: The 90/10 forecast for the statewide coincident summer peak is on average approximately 2,400 MW higher than the baseline 50/50 forecast. This higher load would result in the earlier occurrence of the reliability needs identified in the base case as well as the occurrence of new violations in the same four primary regions. In addition, based on the assumptions applied in this analysis, beginning in 2017 there would be insufficient resources to meet the minimum 10-minute operating reserve requirement of 1,310 MW. Starting in 2020, there would be insufficient resources to meet the modeled 90/10 peak load under pre-contingency conditions.
- *Stressed Winter Scenario*: The winter of 2013-2014 experienced five major cold snaps, including three polar vortex events that extended across much of the country. The NYISO set a new winter peak load of 25,738 MW, while neighboring ISOs and utilities concurrently set record winter peaks during the month of January. Compounding the impact from high load conditions, extensive generation derates and gas pipeline constraints occurred simultaneously due to the extreme winter weather. In the extreme case that NYCA is assumed to be unable to receive any emergency assistance from neighboring areas, it would take a loss of capacity in excess of 7,250 MW due to energy production constraints in extreme winter conditions to cause a resource adequacy violation in 2015.

In addition to the scenarios, the NYISO also analyzed the risks associated with the cumulative impact of environmental laws and regulations, which may affect the flexibility in plant operation and may make fossil plants energy-limited resources. The RNA discusses the environmental regulations that affect long term power system planning and highlights the impacts of various environmental drivers on resource availability.

The RNA is the first step of the NYISO reliability planning process. As a product of this step, the NYISO documents the reliability needs in the RNA report, which is presented to the NYISO Board of Directors for approval. The NYISO Board approval initiates the second step, which involves the NYISO requesting proposed solutions to mitigate the identified needs to maintain acceptable levels of system reliability throughout the study period.

As part of its ongoing reliability planning process, the NYISO monitors and tracks the progress of market-based projects, regulated backstop solutions, together with other resource additions and retirements, consistent with its obligation to protect confidential information under its Code of Conduct. The other tracked resources include: (i) units interconnecting to the bulk power transmission system; (ii) the development and installation of local transmission facilities; (iii) additions, mothballs or retirement of generators; (iv) the status of mothballed/retired facilities; (v) the continued implementation of New York State energy efficiency and similar programs; (vi) participation in the NYISO demand response programs; and (vii) the impact of new and proposed environmental regulations on the existing generation fleet.

1. Introduction

The Reliability Needs Assessment (RNA) is developed by the NYISO in conjunction with Market Participants and all interested parties as its first step in the Comprehensive System Planning Process (CSPP). The RNA is the foundation study used in the development of the NYISO Comprehensive Reliability Plan (CRP). The RNA is performed to evaluate electric system reliability, for both transmission security and resource adequacy, over a 10-year study period. If the RNA identifies any violation of Reliability Criteria for Bulk Power Transmission Facilities (BPTF), the NYISO will report a Reliability Need quantified by an amount of compensatory megawatts (MW). After approval of the RNA, the NYISO will request market-based and alternative regulated proposals from interested parties to address the identified Reliability Needs, and designate one or more Responsible Transmission Owners to develop a regulated backstop solution to address each identified Reliability Need. This report sets forth the NYISO's findings for the study period 2015-2024.

The CRP will provide a plan for continued reliability of the bulk power system during the study period depending on a combination of additional resources. The resources may be provided by market-based solutions being developed in response to market forces and the request for solutions following the approval of this RNA. If the market does not adequately respond, continued reliability will be ensured by either regulated solutions being developed by the TOs which are obligated to provide reliable service to their customers or alternative regulated solutions being developed by others. To maintain the system's long-term reliability, these additional resources must be readily available or in development at the appropriate time of need. Just as important as the electric system plan is the process of planning itself. Electric system planning is an ongoing process of evaluating, monitoring and updating as conditions warrant. Along with addressing reliability, the CSPP is also designed to provide information that is both informative and of value to the New York wholesale electricity marketplace.

Proposed solutions that are submitted in response to an identified Reliability Need are evaluated in the development of the CRP and must satisfy Reliability Criteria. However, the solutions submitted to the NYISO for evaluation in the CRP do not have to be in the same amounts of MW or locations as the compensatory MW reported in the RNA. There are various combinations of resources and transmission upgrades that could meet the needs identified in the RNA. The reconfiguration of transmission facilities and/or modifications to operating protocols identified in the solution phase could result in changes and/or modifications of the needs identified in the RNA.

This report begins with a summary of the 2012 CRP and prior reliability plans. The report continues with a summary of the load and resource forecast for the next 10 years, RNA base case assumptions and methodology, and reports the RNA findings for years 2015 through 2024. Detailed analyses, data and results, and the underlying modeling assumptions are contained in the appendices.

The RPP tests the robustness of the needs assessment studies and determines, through the development of appropriate scenarios, factors and issues that might adversely impact the reliability of the BPTF. The scenarios that were considered include: (i) high load (econometric forecast prior to inclusion of statewide energy efficiency programs and retail solar photovoltaic (PV), that increases the load by approximately 2,000 MW by 2024); (ii) Indian Point Plant retirement; (iii) 90/10 load forecast; (iv) zonal capacity at risk; and (v) stressed winter conditions. In addition to assessing the base case conditions and scenarios, the impact of the Dunkirk plant fuel conversion is analyzed as a sensitivity.

The NYISO will prepare and issue its 2014 CRP based upon this 2014 RNA report. The NYISO will monitor the assumptions underlying the RNA base case as well as the progress of the market-based solutions submitted in earlier CRPs and projects that have met the NYISO's base case inclusion rules for this RNA. These base case assumptions include, but are not limited to, the measured progress towards achieving the State energy efficiency program standards, the impact(s) of ongoing developments in State and Federal environmental regulatory programs on existing power plants, the status of plant re-licensing efforts, and the development of transmission owner projects identified in the Local Transmission Plans (LTPs).

For informational purposes, this RNA report also provides the marketplace with the latest historical information available for the past five years of congestion via a link to the NYISO's website. The 2014 CRP will be the foundation for the 2015 Congestion Assessment and Resource Integration Study (CARIS). A more detailed evaluation of system congestion is presented in the CARIS.

2. Summary of Prior CRPs

This is the seventh RNA since the NYISO planning process was approved by FERC in December 2004. The first three RNA reports identified Reliability Needs and the first three CRPs (2005-2007) evaluated the market-based and regulated backstop solutions submitted in response to those identified needs. The 2009 CRP and the 2010 CRP indicated that the system did not exhibit any violations of applicable reliability criteria and no solutions were necessary to be solicited. Therefore, market-based and regulated solutions were not requested. The 2012 RNA identified Reliability Needs and the 2012 CRP evaluated market-based and regulated solutions in response to those needs. The NYISO has not previously triggered any regulated backstop solutions to meet previously identified Reliability Needs due to changes in system conditions and sufficiency of projects coming into service.

Table 2-1 presents the market solutions and TOs' plans that were submitted in response to previous requests for solutions. These solutions were included in the 2012 CRP and the information concerning these solutions has been updated herein to reflect their current status. The table also indicates that 1,545 MW of solutions are either in-service or are still being reported to the NYISO as moving forward with the development of their projects.

In addition to those projects in Table 2-1, there are a number of other projects in the NYISO interconnection study queue which are also moving forward through the interconnection process, but have not been offered as market solutions in this process. Some of these additional generation resources have either accepted their cost allocation as part of a Class Year Facilities Study process or are included in the currently ongoing 2012 Class Year Facilities Study. These projects are listed in Table 2-2 and 2-3 in the order of each project's proposed in-service dates. The projects that meet the 2014 RNA base case inclusion rules are included in Table 3-3. The listings of other Class Year Projects can be found along with other projects that have not met inclusion rules.

Table 2-1: Current Status of Tracked Market-Based Solutions & TOs' Plans

Queue #	Project	Submitted	Zone	Original In-Service Date	Name Plate (MW)	CRIS (MW)	Summer (MW)	Proposal Type	Current Status	Included in 2014 RNA Base Case?
69	Empire Generation Project	CRP 2008	F	Q1 2010	670	592.4	577.1	Resource Proposal	In-Service	Yes
206	Back-to-Back HVDC, AC Line HTP	CRP 2007, CRP 2008, and was an alternative regulated proposal in CRP 2005	PJM - J	Q2 2011	660	660	660	Transmission Proposal	In-Service	Yes
153	ConEd M29 Project	CRP 2005	J	May 2010	N/A	N/A	N/A	TO's Plans	In-Service	Yes
-	Sta 80 xfmr replacement	CRP 2012	B	2014	N/A	N/A	N/A	TO's Plans	In-Service	Yes
-	Ramapo Protection Addition	CRP2012	G	2013	N/A	N/A	N/A	TO's Plans	In-Service	Yes
-	5 Mile Road Substation	CRP2012	A	-	N/A	N/A	N/A	TO's Plans	Summer 2015	Yes
201, 224	Gas Turbine NRG Astoria re-powering	CRP 2005, CRP 2007, CRP 2008, CRP 2012	J	June 2010	278.9	155	250	Resource Proposal	June 2017	No
339	Station 255	CRP 2012	B	-	N/A	N/A	N/A	TO's Plans	Q4 2016	Yes
-	Clay – Teall #10 115kV	CRP2012	C	2016	N/A	N/A	N/A	TO's Plans	Q4 2017	Yes

Table 2-2: Proposed Generation Projects from Completed Class Years

Queue #	Owner/Operator	Station Unit	Zone	Proposed In-Service Date	Name Plate (MW)	CRIS (MW)	Summer (MW)	Unit Type	Class Year	Included in 2014 RNA?
237	Allegany Wind, LLC	Allegany Wind	A	2015/11	72.5	0.0	72.5	Wind Turbines	2010	No
197	PPM Roaring Brook, LLC / PPM	Roaring Brook Wind	E	2015/12	78.0	0.0	78.0	Wind Turbines	2008	No
349	Taylor Biomass Energy Mont., LLC	Taylor Biomass	G	2015/12	21.0	19.0	19.0	Solid Waste	2011	Yes
251	CPV Valley, LLC	CPV Valley Energy Center	G	2016/05	820.0	680.0	677.6	Combined Cycle	2011	No
201	NRG Energy	Berrians GT	J	2017/06	200.0	155.0	200.0	Combined Cycle	2011	No
224	NRG Energy, Inc.	Berrians GT II	J	2017/06	78.9	0.0	50.0	Combined Cycle	2011	No

Table 2-3: Other Proposed Generation Projects

Queue #	Owner/Operator	Station Unit	Zone	Proposed In-Service Date	Name Plate (MW)	CRIS (MW)	Summer (MW)	Unit Type	Included in 2014 RNA?
372	Dry Lots Wind, LLC	Dry Lots Wind	E	2014/11	33.0	TBD	33.0	Wind Turbines	No
354	Atlantic Wind, LLC	North Ridge Wind	E	2014/12	100.0	TBD	100.0	Wind Turbines	No
276	Air Energie TCI, Inc.	Crown City Wind	C	2014/12	90.0	TBD	90.0	Wind Turbines	No
371	South Moutain Wind, LLC	South Mountain Wind	E	2014/12	18.0	TBD	18.0	Wind Turbines	No
361	US PowerGen Co.	Luyster Creek Energy	J	2015/06	508.6	TBD	401.0	Combined Cycle	No
360	NextEra Energy Resources, LLC	Watkins Glen Wind	C	2015/07	122.4	TBD	122.4	Wind Turbines	No
382	Astoria Generating Co.	South Pier Improvement	J	2015/07	190.0	TBD	88.0	Combustion Turbines	No
347	Franklin Wind Farm, LLC	Franklin Wind	E	2015/12	50.4	TBD	50.4	Wind Turbines	No
270	Wind Development Contract Co, LLC	Hounsfield Wind	E	2015/12	244.8	TBD	244.8	Wind Turbines	No
266	NRG Energy, Inc.	Berrians GT III	J	2016/06	278.9	TBD	250.0	Combined Cycle	No
383	NRG Energy, INC.	Bowline Gen. Station Unit #3	G	2016/06	814.0	TBD	775.0	Combined Cycle	No
310	Cricket Valley Energy Center, LLC	Cricket Valley Energy Center	G	2018/01	1308.0	TBD	1019.9	Combined Cycle	No
322	Rolling Upland Wind Farm, LLC	Rolling Upland Wind	E	2018/10	59.9	TBD	59.9	Wind Turbines	No

3. RNA Base Case Assumptions, Drivers and Methodology

The NYISO has established procedures and a schedule for the collection and submission of data and for the preparation of the models used in the RNA. The NYISO's CSPP procedures are designed to allow its planning activities to be performed in an open and transparent manner under a defined set of rules and to be aligned and coordinated with the related activities of the NERC, NPCC, and New York State Reliability Council (NYSRC). The assumptions underlying the RNA were reviewed at the Transmission Planning Advisory Subcommittee (TPAS) and the Electric System Planning Working Group (ESPWG). The Study Period analyzed in the 2014 RNA is the ten years from 2015 through 2024 for the base case, sensitivity and scenarios.

All studies and analyses of the RNA base case reference the same energy and peak demand forecast, which is the baseline forecast reported in the 2014 Gold Book. The baseline forecast is an econometric forecast with an adjustment to reflect projected gains (i.e., load reduction) associated with statewide energy efficiency programs and retail solar PV installations.

The study base cases were developed in accordance with NYISO procedures using projections for the installation and retirement of generation resources and transmission facilities that were developed in conjunction with market participants and Transmission Owners. These are included in the base case using the NYISO 2014 FERC 715 filing as a starting point, and consistent with the base case inclusion screening process provided in the Reliability Planning Process (RPP) Manual. Resources that choose to participate in markets outside of New York are modeled as contracts, thus preventing their capacity from being used to meet resource adequacy requirements in New York. Representations of neighboring systems are derived from interregional coordination conducted under the NPCC, and pursuant to the Northeast ISO/RTO Planning Coordination Protocol.

Table 3-3 shows the new projects which meet the screening requirements for inclusion in the RNA base case.

3.1. Annual Energy and Summer Peak Demand Forecasts

There are two primary forecasts modeled in the 2014 RNA, as contained in the 2014 Gold Book. The first forecast, which is used in a scenario, is an econometric forecast of annual energy and peak demand. The second forecast, which is used for the 2014 RNA base case, includes projected reductions for the impacts of energy efficiency programs and retail solar PV power[1].

The NYISO's energy efficiency estimates include the impact of programs authorized by the Energy Efficiency Portfolio Standards (EEPS), New York Power Authority (NYPA), and Long Island Power Authority (LIPA). The NYISO has been a party to the EEPS proceeding from its inception and is now an *ex-officio* member of the E^2 advisory group, the successor to the Evaluation Advisory Group, which is responsible for advising the New York State Public Service Commission (NYDPS) on energy efficiency related issues and topics. The NYISO reviewed and discussed with market participants in the ESPWG and TPAS, projections for the potential impact of both energy efficiency and the EEPS over the 10-year Study Period. The factors considered in developing the 2014 RNA base case forecast are included in Appendix C.

The assumptions for the 2014 economic growth, energy efficiency program impacts and retail solar PV impacts were discussed with market participants during meetings of the ESPWG and TPAS during the first quarter of 2014. The ESPWG and TPAS reviewed and discussed the assumptions used in the 2014 RNA base case forecast in accordance with procedures established for the RNA.

The annual average energy growth rate in the 2014 Gold Book decreased to 0.16%, as compared to 0.59% in the 2012 Gold Book. The 2014 Gold Book's annual average summer peak demand growth decreased to 0.83%, as compared to 0.85% in the 2012 Gold Book. The lower energy growth rate is attributed to the influence of both the economy and the continued impact of energy efficiency and retail solar PV. While these factors had a smaller impact on summer peak growth than on annual energy growth, the expectation for peak growth is still lower in 2014 than it was in 2012. Due to the low growth rates in both energy and summer peak demand, the value in performing a low-growth scenario for the RNA was diminished, and thus, this scenario was not modeled in the 2014 RNA.

Table 3-1 below summarizes the 2014 RNA econometric forecast and the 2012 RNA base case forecast. Table 3-1 shows a comparison of the base case forecasts and energy efficiency program impacts contained in the 2012 RNA and the 2014 RNA. Figure 3-1 and Figure 3-2 present actual, weather-normalized and forecasts of annual energy and summer peak demand for the 2014 RNA. Figure 3-3 and Figure 3-4 present the NYISO's projections of annual energy and summer peak demand in the 2014 RNA for energy efficiency and retail solar PV.

[1] The term retail solar PV is used to refer to customer-sited solar PV, to distinguish it from large-scale solar PV that is considered as part of the fleet of electric generation in the state.

Table 3-1: Comparison of 2012 & 2014 RNA Base Case Forecasts

Comparison of Base Case Energy Forecasts - 2012 & 2014 RNA (GWh)

Annual GWh	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2012 RNA Base Case	163,659	164,627	165,340	166,030	166,915	166,997	168,021	169,409	171,176	172,514	173,569		
2014 RNA Base Case			163,161	163,214	163,907	163,604	163,753	164,305	165,101	164,830	164,975	165,109	165,721
Change from 2012 RNA			-2,179	-2,816	-3,008	-3,393	-4,268	-5,104	-6,075	-7,684	-8,594	NA	NA

Comparison of Base Case Peak Forecasts - 2012 & 2014 RNA (MW)

Annual MW	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2012 RNA Base Case	33,295	33,696	33,914	34,151	34,345	34,550	34,868	35,204	35,526	35,913	36,230		
2014 RNA Base Case			33,666	34,066	34,412	34,766	35,111	35,454	35,656	35,890	36,127	36,369	36,580
Change from 2012 RNA			-248	-85	67	216	243	250	130	-23	-103	NA	NA

Comparison of Energy Impacts from Statewide Energy Efficiency Programs & Retail Solar PV - 2012 RNA & 2014 RNA (GWh)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2012 RNA Base Case	1,919	3,462	5,140	6,645	7,903	9,149	10,066	10,670	11,230	11,755	12,244		
2014 RNA Base Case	1,919	3,462	4,823	6,558	8,099	9,395	10,449	11,455	12,439	13,341	14,228	15,108	15,975
Change from 2012 RNA			-317	-87	196	246	383	785	1,209	1,586	1,984	NA	NA

Comparison of Peak Impacts from Statewide Energy Efficiency & Retail Solar PV - 2012 RNA & 2014 RNA (MW)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2012 RNA Base Case	343	624	932	1,210	1,446	1,674	1,861	1,983	2,101	2,217	2,324		
2014 RNA Base Case	343	624	848	1,115	1,372	1,549	1,715	1,867	2,025	2,169	2,314	2,456	2,703
Change from 2012 RNA			-84	-95	-74	-125	-146	-116	-76	-48	-10	NA	NA

Table 3-2: Comparison of 2014 RNA Base Case Forecast and High Load (Econometric) Scenario

Annual GWh	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2014 High Load Scenario	164,522	166,310	168,544	169,537	170,740	172,298	174,078	174,709	175,741	176,755	178,234
2014 RNA Base Case	163,161	163,214	163,907	163,604	163,753	164,305	165,101	164,830	164,975	165,109	165,721

Energy Impacts of EE Programs & Retail Solar PV

Cumulative GWh	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2014 RNA Base Case	1,361	3,096	4,637	5,933	6,987	7,993	8,977	9,879	10,766	11,646	12,513

Annual MW	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2014 High Load Scenario	33,890	34,557	35,160	35,691	36,202	36,697	37,057	37,435	37,817	38,201	38,659
2014 RNA Base Case	33,666	34,066	34,412	34,766	35,111	35,454	35,656	35,890	36,127	36,369	36,580

Summer Peak Demand Impacts of EE Programs & Retail Solar PV

Cumulative MW	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2014 RNA Base Case	224	491	748	925	1,091	1,243	1,401	1,545	1,690	1,832	2,079

Figure 3-1: 2014 Base Case Energy Forecast and Scenarios

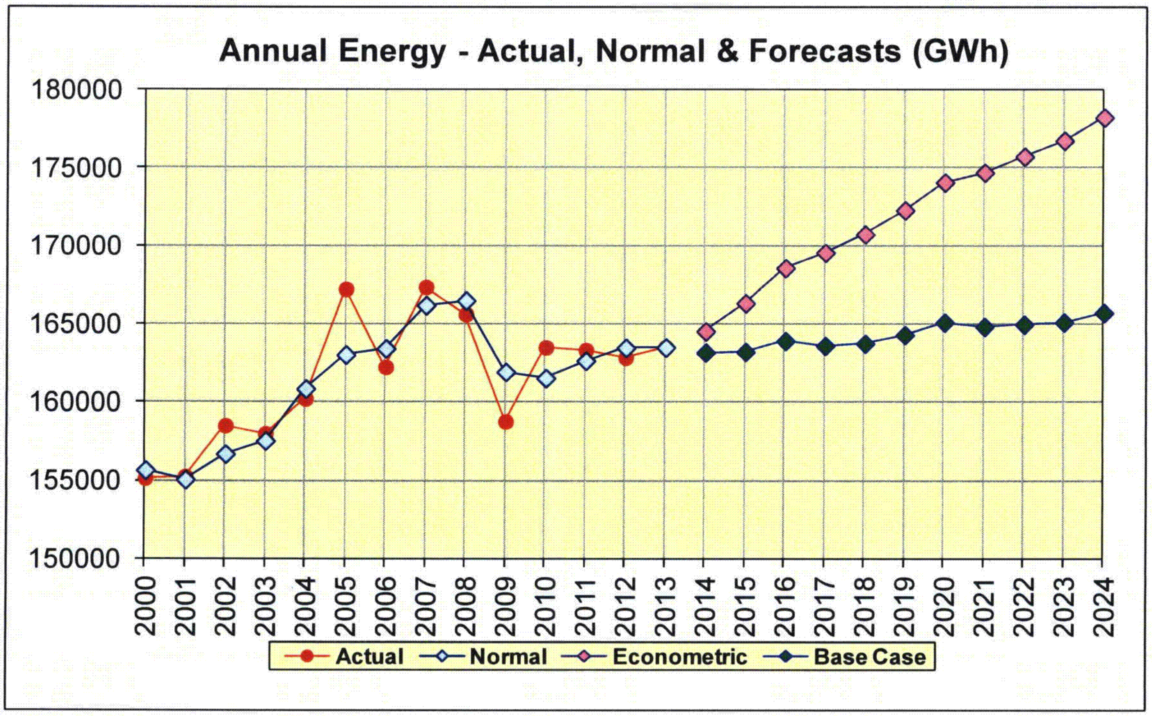
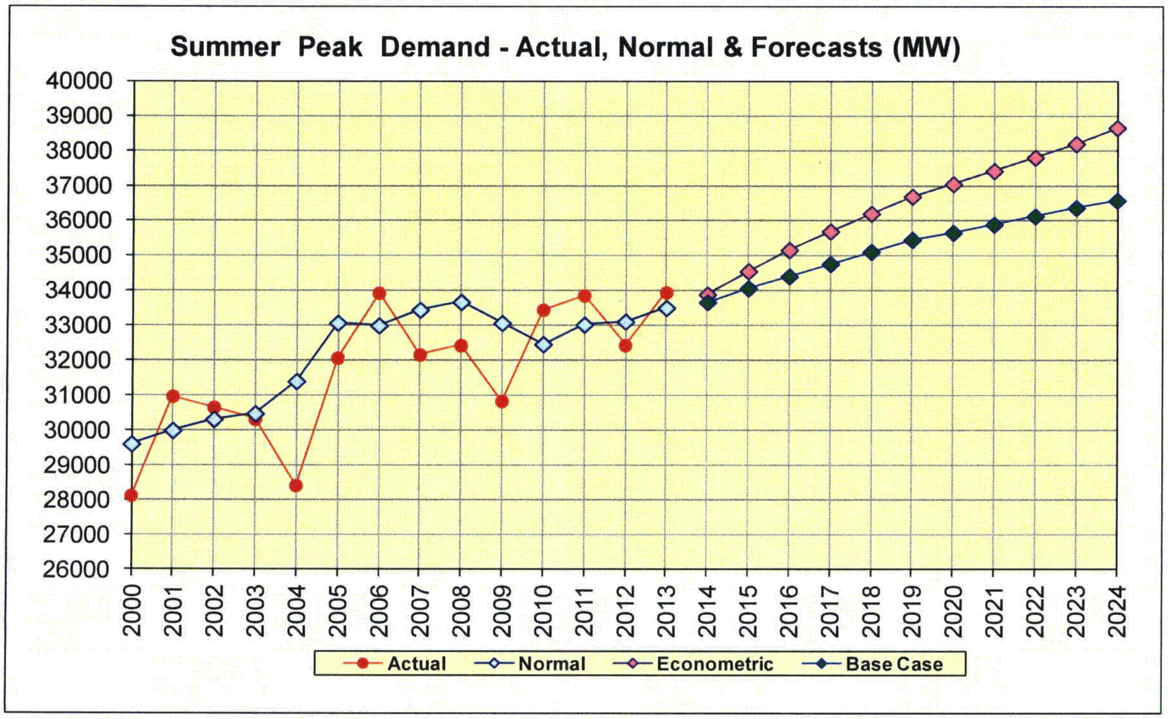


Figure 3-2: 2014 Base Case Summer Peak Demand Forecast and Scenarios



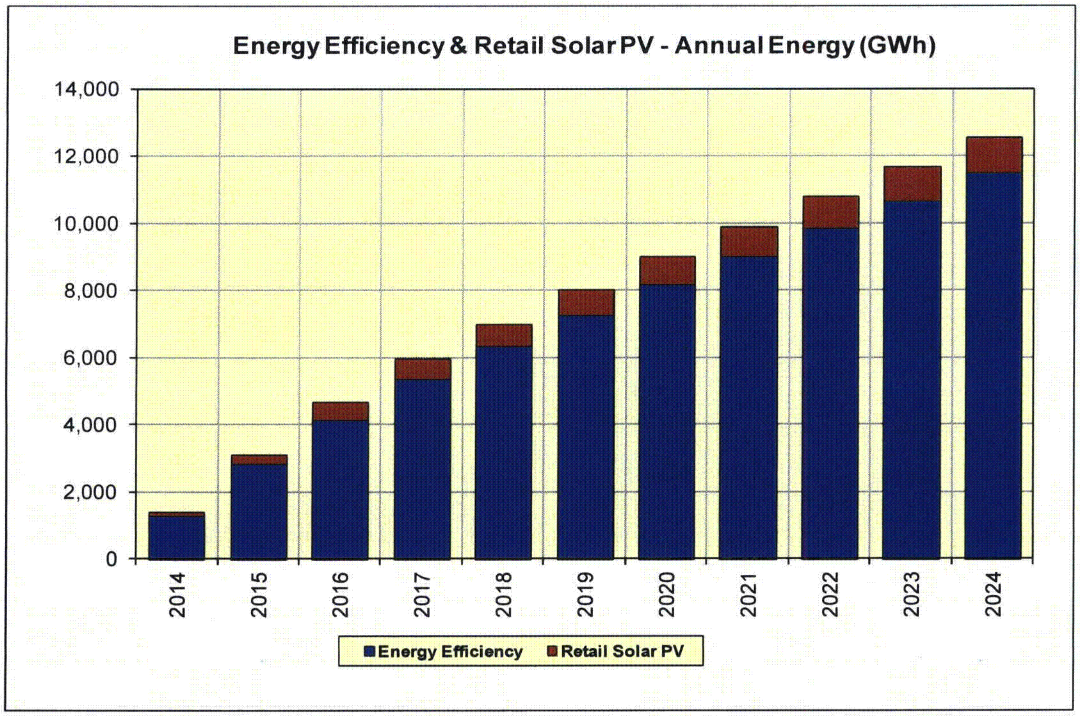


Figure 3-3: 2014 Base Case Energy Efficiency & Retail Solar PV – Annual Energy

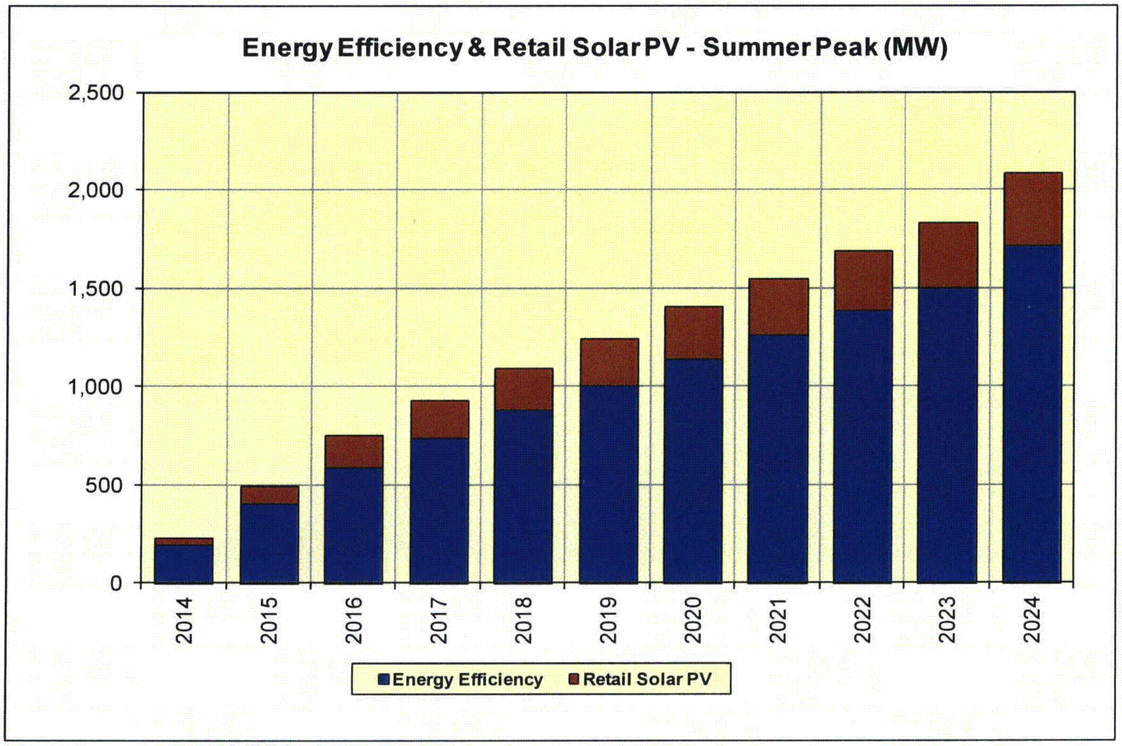


Figure 3-4: 2014 Base Case Energy Efficiency & Retail Solar PV – Summer Peak

3.2. Forecast of Special Case Resources

The 2014 RNA special case resource (SCR) levels are based on the 2014 Gold Book value of 1,189 MW. The MARS program used for resource adequacy analysis calculates the SCR values for each hour based on the ratio of hourly load to peak load. Transmission security analysis, which evaluates normal transfer criteria, does not consider SCRs.

3.3. Resource Additions and Removal

Since the 2012 RNA, resources have been added to the system, some mothball notices have been withdrawn and the associated facilities have returned to the system and some resources have been removed. A total of 455.9 MW have been added to the 2014 RNA base case either as new generation or existing units returning to service. Meanwhile, a total of 1,368.8 MW have been removed from the 2012 RNA base case because these units have retired, mothballed, or proposed to retire/mothball. The comparison of generation status between the 2012 RNA and 2014 RNA is detailed in Table 3-3 below. The MW values represent the Capacity Resources Interconnection Service (CRIS) MW values as shown in the 2014 Gold Book.

Table 3-3: Generation Addition and Removal

Station Unit	Zone	CRIS (MW)	2012 RNA Status*	2014 RNA Status*
Resource Addition				
Stony Creek Wind	C	93.9	N/A	I/S since Nov. 2013
Taylor Biomass	G	19.0	N/A	I/S starting Dec. 2015
Astoria GT 10	J	24.9	O/S	I/S return to service since July 15, 2013
Astoria GT 11	J	23.6	O/S	I/S return to service since July 15, 2013
Gowanus 1	J	154.4	O/S	I/S (Intent to Retire Notice withdrawn)
Gowanus 4	J	140.1	O/S	I/S (Intent to Retire Notice withdrawn)
Total Resource Addition (CRIS MW)		**455.9**		
Resource Removal				
Dunkirk 2	A	97.2	O/S	I/S until May, 31 2015
RG&E Station 9	B	14.3	I/S	O/S
Seneca Oswego Fulton 1	C	0.7	I/S	O/S
Seneca Oswego Fulton 2	C	0.3	I/S	O/S
Syracuse Energy ST1	C	11.0	I/S	O/S
Syracuse Energy ST2	C	58.9	I/S	O/S
Cayuga 1	C	154.1	I/S	I/S until June 30 2017
Cayuga 2	C	154.1	I/S	I/S until June 30 2017
Chateaugay Power	D	18.2	I/S	O/S
Selkirk-I	F	76.1	I/S	O/S, Intent to Mothball Notice issued in Feb. 2014**
Selkirk-II	F	271.6	I/S	O/S, Intent to Mothball Notice issued in Feb. 2014**
Danskammer 1	G	61.0	I/S	O/S, Intent to Retire Notice issued in Jan. 2013***
Danskammer 2	G	59.2	I/S	O/S, Intent to Retire Notice issued in Jan. 2013***
Danskammer 3	G	137.2	I/S	O/S, Intent to Retire Notice issued in Jan. 2013***
Danskammer 4	G	236.2	I/S	O/S, Intent to Retire Notice issued in Jan. 2013***
Danskammer 5	G	0.0	I/S	O/S, Intent to Retire Notice issued in Jan. 2013***
Danskammer 6	G	0.0	I/S	O/S, Intent to Retire Notice issued in Jan. 2013***
Ravenswood 07	J	12.7	I/S	O/S
Montauk 2, 3, 4	K	6.0	I/S	O/S
Total Resource Removal (CRIS MW)		**1368.8**		

* I/S for In-Service, and O/S for Out-of-Service

** Following the completion of this RNA report, Selkirk Cogen Partners, in a letter dated Sept 3, 2014, withdrew their earlier notice of intent to mothball Selkirk Units 1 & 2.

***On June 27, 2014, the PSC approved the transfer of the Danskammer facility to Helios Power Capital, LLC, and Mercuria Energy America, Inc. Following the transfer, the owners have stated their intent to return the Danskammer facility to operation.

3.4. Local Transmission Plans

As part of the Local Transmission Planning Process (LTPP), Transmission Owners presented their Local Transmission Plans (LTPs) to the NYISO and Stakeholders in the fall of 2013. The NYISO reviewed the LTPs and included them in the 2014 Gold Book. The firm transmission plans included in the 2014 RNA base case are reported in Appendix D. Assumptions for inclusion in the RNA were based on data as of April 1, 2014.

3.5. Bulk Transmission Projects

Since the 2012 RNA some additional transmission projects have met the inclusion rules and are in the 2014 RNA base case. The National Grid Five Mile Road project includes tapping the Homer City-Stolle Rd. 345 kV circuit and connecting to a new 115 kV station through one 345/115 kV transformer. The National Grid Eastover Rd. project consists of tapping the Rotterdam-Bear Swamp 230 kV circuit and connecting to a new 115 kV station with two 230/115 kV transformers (one spare). These projects are modeled as in-service by summer of 2015.

The Transmission Owner Transmission Solutions (TOTS) is a group of projects by NYPA, NYSEG, and ConEdison that includes three primary projects. The first is Marcy South Series Compensation, which includes the installation of series capacitance at the Marcy station on the Marcy-Coopers Corners 345 kV circuit, and at Fraser station on the Edic-Fraser 345 kV and the Fraser-Coopers Corners 345 kV circuits. A section of the Fraser-Coopers Corners 345 kV circuit will also be reconductored. The second project is Rock Tavern-Ramapo, which includes building an additional 345 kV circuit between Rock Tavern and Ramapo and a 345/138 kV tap connecting to the existing Sugarloaf 138 kV station. The third project is Staten Island Unbottling, which includes the reconfiguration of Goethals and Linden CoGen substations as well as the installation of additional cooling on the 345 kV cables from Goethals to Gowanus and Gowanus to Farragut. The TOTS projects are scheduled to be completed by summer of 2016.

An additional 345/115 kV transformer is modeled as in-service at the NYSEG Wood Street station by the summer of 2016. An additional 230/115/34.5 kV transformer will also be installed at the NYSEG Gardenville substation by the summer of 2017.

The RGE Station 255 project that taps the existing Somerset-Rochester and Niagara-Rochester 345 kV circuits is in the 2014 RNA base case. An additional 345 kV line will be added from Station 255 to Station 80. Station 255 will have two 345/115 kV transformers connecting to a new 115kV station in the Rochester area. These projects, collectively known as the Rochester Area Reliability Project, are modeled as in-service by 2017. Also since the 2012 RNA, two 345/115 kV transformers (T1 and T3) located at RGE Station 80 have been replaced with transformers which have higher ratings, and are modeled accordingly in the 2014 RNA base case.

During the development of the 2012 CRP, National Grid proposed a project to mitigate potential overloads around the Clay substation by reconductoring the Clay-Teall (#10) 115 kV circuit by winter 2017. This upgrade is modeled as part of the 2014 RNA base case starting in the year 2018.

Two FirstEnergy projects within Pennsylvania that tap NYSEG transmission lines are included in the 2014 RNA base case: the Farmers Valley project, which taps the Homer City-Five Mile Rd. 345 kV tie-line, and the Mainesburg project, which taps the Homer City-Watercure 345 kV tie-line. Both projects are modeled as in-service for summer 2015.

3.6. Base Case Peak Load and Resource Ratios

The capacity used for the 2014 RNA base case peak load and resource ratio is the existing generation adjusted for the unit retirements, mothballing, or proposals to retire/mothball announced as of April 15, 2014 along with the new resource additions that met the base case inclusion rules reported in the 2014 Gold Book. This capacity is summarized in Table 3-4 below.

Table 3-4: NYCA Peak Load and Resource Ratios 2015 through 2024

	Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
	Peak Load (MW)										
	NYCA*	34,066	34,412	34,766	35,111	35,454	35,656	35,890	36,127	36,369	36,580
	Zone J*	12,050	12,215	12,385	12,570	12,700	12,790	12,900	12,990	13,100	13,185
	Zone K*	5,543	5,588	5,629	5,668	5,708	5,748	5,789	5,831	5,879	5,923
	Zone G-J	16,557	16,749	16,935	17,149	17,311	17,421	17,554	17,694	17,828	17,935
	Resources (MW)										
	Capacity**	37,375	37,394	37,085	37,085	37,085	37,085	37,085	37,085	37,085	37,085
	Net Purchases & Sales	2,237	2,237	2,237	2,237	2,237	2,237	2,237	2,237	2,237	2,237
	SCR	1,189	1,189	1,189	1,189	1,189	1,189	1,189	1,189	1,189	1,189
NYCA	Total Resources	**40,801**	**40,820**	**40,511**	**40,511**	**40,511**	**40,511**	**40,511**	**40,511**	**40,511**	**40,511**
	Capacity/Load Ratio	109.7%	108.7%	106.7%	105.6%	104.6%	104.0%	103.3%	102.7%	102.0%	101.4%
	Cap+NetPurch/Load Rat	116.3%	115.2%	113.1%	112.0%	110.9%	110.3%	109.6%	108.8%	108.1%	107.5%
	Tot.Res./Load Ratio	119.8%	118.6%	116.5%	115.4%	114.3%	113.6%	112.9%	112.1%	111.4%	110.7%
Zone J	Total Resources	**10,797**	**10,797**	**10,797**	**10,797**	**10,797**	**10,797**	**10,797**	**10,797**	**10,797**	**10,797**
	Tot.Res./Load Ratio	89.6%	88.4%	87.2%	85.9%	85.0%	84.4%	83.7%	83.1%	82.4%	81.9%
Zone K	Total Resources	**6,360**	**6,360**	**6,360**	**6,360**	**6,360**	**6,360**	**6,360**	**6,360**	**6,360**	**6,360**
	Tot.Res./Load Ratio	114.7%	113.8%	113.0%	112.2%	111.4%	110.6%	109.9%	109.1%	108.2%	107.4%
Zone G-J	Total Resources	15,137	15,137	15,137	15,137	15,137	15,137	15,137	15,137	15,137	15,137
	Tot.Res./Load Ratio	91.4%	90.4%	89.4%	88.3%	87.4%	86.9%	86.2%	85.5%	84.9%	84.4%

*NYCA load values represent baseline coincident summer peak demand. Zones J and K load values represent non-coincident summer peak demand. Aggregate Zones G-J values represent G-J coincident peak, which is non-coincident with NYCA.

**NYCA Capacity values include resources electrically internal to NYCA, additions, reratings, and retirements (including proposed retirements and mothballs). Capacity values reflect the lesser of CRIS and DMNC values. NYCA resources include the net purchases and sales as per the Gold Book. Zonal totals include the awarded UDRs for those capacity zones.

Notes:

- SCR - Forecasted ICAP value based on 2014 Gold Book.
- Wind generator summer capacity is counted as 100% of nameplate rating.
- The NYISO set a deadline of May 15, 2014 for deciding whether to include Dunkirk fuel conversion project in the base case or to study it separately as a sensitivity. The NYISO subsequently determined to study it separately as a sensitivity.

For summer 2014 resource adequacy, the existing capacity provides about a 122.7% Installed Capacity Reserve to meet the summer 2014 Installed Reserve Margin requirement of 117.0%. The capacity margin decreases throughout the study period, but more rapidly and noticeably in the outer years due to load growth. Consequently, the reliability need year has advanced to 2019. To demonstrate the significant reduction in resources, the NYISO compared the capacity margin in the need year of 2019 between the 2012 RNA and the 2014 RNA. The NYISO found a net capacity margin decrease of 2,100 MW, which breaks down as follows, and summarized in Table 3-5:

1. The NYCA capacity resources are 874 MW less for 2019 (724 MW upstate and 150 MW in SENY);
2. The NYCA baseline load forecast is 250 MW higher for 2019 (497 MW higher upstate and 247 MW lower in SENY); and
3. The NYCA Special Case Resources (SCRs) projection is 976 MW less for 2019 (685 MW upstate and 291 MW in SENY).

This reduction contributes to the shift of the need year from 2020 to 2019 identified in the 2014 RNA, and discussed in Section 4.

Table 3-5: Load/Resources Comparison of Year 2019 (MW)

Year 2019	2012 RNA	2014 RNA	delta
Load	35,204	35,454	250
SCR	2,165	1,189	-976
Total Capacity without SCRs	40,196	39,322	-874
Net Change in capacity margin in 2014 RNA from 2012 RNA (MW)			-2,100

3.7. Methodology for the Determination of Needs

Reliability Needs are defined by the Open Access Transmission Tariff (OATT) in terms of total deficiencies relative to Reliability Criteria determined from the assessments of the BPTFs performed for the RNA. There are two steps to analyzing the reliability of the BPTFs. The first is to evaluate the security of the transmission system; the second is to evaluate the adequacy of the system, subject to the security constraints. The NYISO planning procedures include both security and adequacy assessments. The transmission adequacy and the resource adequacy assessments are performed together.

Transmission security is the ability of the power system to withstand disturbances such as short circuits or unanticipated loss of system elements and continue to supply and deliver electricity. Security is assessed deterministically, with potential disturbances being applied without concern for the likelihood of the disturbance in the assessment. These disturbances (single-element and multiple-element contingencies) are categorized as the design criteria contingencies, explicitly defined in the NYSRC Reliability Rules. The impacts when applying these design criteria contingencies are assessed to ensure no thermal loading, voltage or stability violations will occur. In addition, the NYISO performs a short circuit analysis to determine if the system can clear faulted facilities reliably under short circuit conditions. The NYISO "Guideline for Fault Current Assessment" describes the methodology for that analysis.

The analysis for the transmission security assessment is conducted in accordance with NERC Reliability Standards, NPCC Transmission Design Criteria, and the NYSRC Reliability Rules. AC contingency analysis is performed on the BPTF to evaluate thermal and voltage performance under design contingency conditions using the Siemens PTI PSS®E and PowerGEM TARA programs. Generation is dispatched to match load plus system losses, while respecting transmission security. Scheduled inter-area transfers modeled in the base case between the NYCA and neighboring systems are held constant.

For the RNA, approximately 1,000 design criteria contingencies are evaluated under N-1, N-1-0, and N-1-1 normal transfer criteria conditions to ensure that the system is planned to meet all applicable reliability criteria. To evaluate the impact of a single event from the normal system condition (N-1), all design criteria contingencies are evaluated including: single element, common structure, stuck breaker, generator, bus, and HVDC facilities contingencies. An N-1 violation occurs when the power flow on the monitored facility is greater than the applicable post-contingency rating. N-1-0 and N-1-1 analysis evaluates the ability of the system to meet design criteria after a critical element has already been lost. For N-1-0 and N-1-1 analysis, single element contingencies are evaluated as the first contingency; the second contingency (N-1-1) includes all design criteria contingencies evaluated under N-1 conditions.

The process of N-1-0 and N-1-1 testing allows for corrective actions including generator redispatch, phase angle regulator (PAR) adjustments, and HVDC adjustments between the first and second contingency. These corrective actions prepare the system for the next contingency by reducing the flow to normal rating after the first contingency. An N-1-0 violation occurs when the flow cannot be reduced to below the normal rating following the first contingency. An N-1-1 violation occurs when the facility is reduced to below the normal rating following the first contingency, but the power flow following the second contingency is greater than the applicable post-contingency rating.

Resource adequacy is the ability of the electric systems to supply the aggregate electricity demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system elements. Resource adequacy considers the transmission systems, generation resources, and other capacity resources, such as demand response. Resource adequacy assessments are performed on a probabilistic basis to capture the random natures of system element outages. If a system has sufficient transmission and generation, the probability of an unplanned disconnection of firm load is equal to or less than the system's standard, which is expressed as a Loss of Load Expectation (LOLE). The New York

State bulk power system is planned to meet a LOLE that, at any given point in time, is less than or equal to an involuntary load disconnection that is not more frequent than once in every 10 years, or 0.1 events per year. This requirement forms the basis of New York's Installed Reserve Margin (IRM) requirement and is on a statewide basis.

If Reliability Needs are identified, various amounts and locations of compensatory MW required for the NYCA to satisfy those needs are determined to translate the criteria violations to understandable quantities. Compensatory MW amounts are determined by adding generic capacity resources to zones to effectively satisfy the needs. The compensatory MW amounts and locations are based on a review of binding transmission constraints and zonal LOLE determinations in an iterative process to determine various combinations that will result in Reliability Criteria being met. These additions are used to estimate the amount of resources generally needed to satisfy Reliability Needs. The compensatory MW additions are not intended to represent specific proposed solutions. Resource needs could potentially be met by other combinations of resources in other areas including generation, transmission and demand response measures.

Due to the differing natures of supply and demand-side resources and transmission constraints, the amounts and locations of resources necessary to match the level of compensatory MW needs identified will vary. Resource needs could be met in part by transmission system reconfigurations that increase transfer limits, or by changes in operating protocols. Operating protocols could include such actions as using dynamic ratings for certain facilities, invoking operating exceptions, or establishing special protection systems.

The procedure to quantify compensatory MW for BPTF transmission security violations is a separate process from calculating compensatory MW for resource adequacy violations. This quantification is performed by first calculating transfer distribution factors (TDF) on the overloaded facilities. The power transfer used for this calculation is created by injecting power at existing buses within the zone where the violation occurs, and reducing power at an aggregate of existing generators outside of the area.

4. Reliability Needs Assessment

4.1. Overview

Reliability is defined and measured through the use of the concepts of security and adequacy described in Section 3.

4.2. Reliability Needs for Base Case

Below are the principal findings of the 2014 RNA applicable to the base case conditions for the 2015-2024 study periods including: transmission security assessment; short circuit assessment; resource and transmission adequacy assessment; system stability assessments; and scenario analyses.

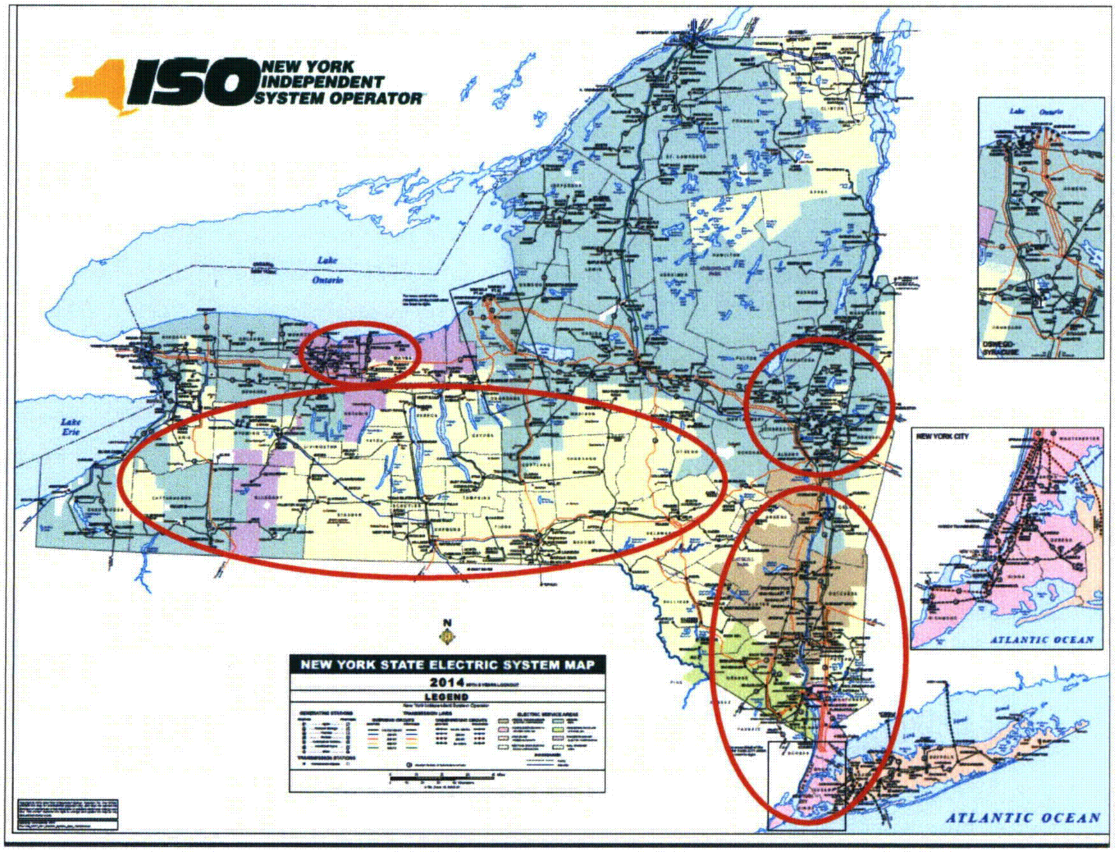
4.2.1. Transmission Security Assessment

The RNA requires analysis of the security of the Bulk Power Transmission Facilities (BPTF) throughout the Study Period (2015-2024). The BPTF, as defined in this assessment, include all of the facilities designated by the NYISO as a Bulk Power System (BPS) element as defined by the NYSRC and NPCC, as well as other transmission facilities that are relevant to planning the New York State transmission system. To assist in the assessment, the NYISO reviewed many previously completed transmission security assessments, and utilized the most recent Area Transmission Review and FERC Form 715 power flow case that the NYISO submitted to FERC.

The transmission security analysis identifies thermal violations on the BPTF throughout the Study Period (2015-2024) for N-1, N-1-0, and N-1-1 conditions, some of which are a continuation of the violations identified in the 2012 RNA for which work is ongoing and some of which represent new violations resulting from system changes modeled in the base case. Table 4-1 provides a summary of the contingency pairs that result in the highest thermal overload on each overloaded BPTF element under N-1, N-1-0, and N-1-1 conditions using coincident peak loading. In the second contingency column of Table 4-1, "N/A" corresponds to an N-1 violation and "Base Case" corresponds to an N-1-0 violation. Table 4-2 provides a summary of the year by which a solution is needed to be in-service to mitigate the transmission security violation. Appendix D provides a summary of all contingency pairs that result in overloads on the BPTF for the study period.

There are four primary regions of Reliability Needs identified in Table 4-1 including: Rochester, Western & Central New York, Capital Region, and Lower Hudson Valley & New York City. These Reliability Needs either continue to be generally driven by, or have arisen anew due to, two primary factors: (i) recent and proposed generator retirements/mothballs; and (ii) combined with load growth. Considering non-coincident peak loading for these regions, the overloads listed in Table 4-1 would increase most notably in the out-years. Figure 4-1 geographically depicts the four regions where the loads may be impacted by transmission security constraints.

Figure 4-1: Approximate Locations of Transmission Security Needs



Rochester

The transmission security analysis continues to show near-term overloads in the Rochester area, primarily due to load growth. The 2012 RNA identified overloaded transformers at Station 80 and Pannell starting in 2013. The Station 80 overloads were resolved by the recently completed replacement of two transformers at that station. The remaining portion of the Rochester Area Reliability Project, Rochester Gas and Electric (RG&E) Station 255, which was provided as a solution in the 2012 CRP is included in the base case starting in 2017 according to the firm plans identified in the 2014 Gold Book.

Starting in 2015, the Pannell 345/115 kV transformer 1TR is overloaded for the loss of Ginna followed by a stuck breaker at Pannell. Pannell 345/115 kV transformer 2TR is similarly overloaded for the loss of Ginna followed by a stuck breaker at Pannell. The Pannell-Quaker (#914) 115 kV line overloads for the loss of Ginna followed by a loss of Pannell 345/115 kV 3TR.

The N-1-1 violations on Pannell 345/115 transformers 1TR and 2TR and Pannell-Quaker (#914) 115 kV are resolved after RG&E Station 255 is in-service.

Western & Central New York

The transmission security analysis identifies a number of thermal and voltage violations on the BPTF in the Western and Central New York regions resulting from a lack of transmission and generating resources to serve load and support voltage in the area.

The 230 kV system between Niagara and Gardenville includes two parallel 230 kV transmission lines from Niagara to Packard to Huntley to Gardenville, including a number of taps to serve load in the Buffalo area. A third parallel 230 kV transmission line also runs from Niagara to Robinson Rd. to Stolle Rd. to Gardenville. The N-1-1 analysis shows that in 2018, Huntley-Gardenville (#80) 230 kV overloads for loss of the parallel line (#79) followed by a stuck breaker at the Robinson Road 230 kV substation. In 2021, the Packard-Huntley (#77) and (#78) lines each overload for the loss of the parallel line followed by a stuck breaker at the Robinson Road 230 kV substation. Similarly, in 2022, the Huntley-Gardenville (#79) line overloads for loss of the parallel line (#80) followed by a stuck breaker at the Robinson Road 230 kV substation. The overloads occur due to increased load in Western and Central New York and are aggravated by both the mothball of Dunkirk generation and a new load-serving 230/115 kV substation (Four Mile Junction) just within the PJM area.

National Grid's Clay 115 kV station includes eight 115 kV transmission connections and two 345/115 kV transformers that serve the Oswego and Syracuse areas. Starting in 2015, the Clay-Lockheed Martin (#14) 115 kV line has a flow of 146 MVA compared to a Long Term Emergency (LTE) rating of 120 MVA for an N-1 breaker failure at the Oswego 345 kV substation. In 2019, the flow increases to 166 MVA. The increase in flow between 2015 and 2019 is primarily due to modeling the Cayuga generation plant out-of-service starting in 2017. The increased load and Dunkirk mothballing in 2015 also contribute to the overload. In 2024, the flow increases to 168 MVA due to load growth. In 2024, the Clay-Woodward (Euclid-Woodard) (#17) 115 kV line has a flow of 183 MVA compared to an LTE rating of 174 MVA due to an N-1 breaker failure at the Lafayette 345 kV substation.

Thermal overloads are also observed at Clay for N-1-1 conditions. Starting in 2015, the N-1-1 analysis shows various overloads in the Syracuse area including: Clay-Lockheed Martin (#14) 115 kV, Clay-Teall (#10) 115 kV, and the Clay-Dewitt (#3) 115 kV line. Starting in 2017, the N-1-1 analysis shows additional overloads on: Clay-Woodard (#17) 115 kV, Clay-S. Oswego (#4) 115 kV, and the Clay 345/115 kV 1TR transformer. In the 2012 RNA, the NYISO identified transmission security violations on Clay-Teall (#10) 115 kV line. The overloads on the Clay-Teall (#10) 115 kV and the Clay-Dewitt (#3) 115 kV lines are mitigated by the solutions identified in the 2012 CRP starting in 2018, as described in Section 3.5 of this report. The Clay-Lockheed Martin (#14) 115 kV line also experiences an N-1-0 violation starting in 2019 for the loss of the Elbridge 345/115 kV transformer. The overloads in this area are primarily due to power flowing from east-to-west on the 115 kV system to serve load in Central New York after the loss of a north-to-south 345 kV path and are exacerbated with Cayuga mothballed.

National Grid's Porter 115 kV station includes eight 115 kV transmission connections and two 345/115 kV transformers that serve the Utica and Syracuse areas. The N-1-1 analysis shows the Porter-Yahnundasis (#3) 115 kV line overloaded starting in 2015 for the loss of Oswego-Elbridge-Lafayette (#17) 345 kV followed by a stuck breaker at the Clay 345 kV substation; additionally, the N-1-1 analysis shows the Porter-Oneida (#7) 115 kV line overloaded starting in 2017 for the same contingency pair. These overloads are due to power flowing from east to west on the 115 kV system to serve load in the Utica, Syracuse, and Finger Lakes area and are exacerbated with Cayuga mothballed.

In addition to the thermal violations identified in Table 4-1, the Porter 115 kV area has local low voltage issues in all years due to a stuck breaker contingency.

The Oakdale 345/230/115 kV substation serves the Binghamton area. Starting in 2015, N-1-1 analysis shows the loading on Oakdale 345/115 kV 2TR is overloaded for the loss of Watercure 345/230 kV 1TR followed by a stuck breaker at Oakdale 345 kV; however, starting in 2016 a second Watercure 345/230 kV transformer (expected in-service date prior to winter 2015) is modeled in-service, which resolves Watercure 345/230 kV transformer from being a limiting contingency. With the second Watercure 345/230 kV transformer in-service in 2016, the limiting contingency pair changes to the loss of Fraser 345/115 kV 2TR followed by a stuck breaker at Oakdale 345 kV. An N-1-0 violation occurs starting in 2016 on Oakdale 345/115 kV 2TR for loss of Oakdale 345/115 kV 3TR and then in 2020 on Oakdale 345/115 kV 3TR for loss of Oakdale 345/115 kV 2TR. The overloads on the Oakdale 345/115 kV transformers are caused by the loss of sources (i.e. transformers) and are exacerbated with Cayuga mothballed.

In addition to the thermal violations identified in Table 4-1, the Oakdale area has low voltage under N-1-1 conditions starting in 2017 for loss of transformer sources into the local area from the bulk system. The low voltage is primarily due to modeling the Cayuga generation plant out-of-service starting in 2017.

Capital Region

In March of 2014, Selkirk Cogen Partners, LLC submitted their notice of intent to mothball the Selkirk I and Selkirk II facilities effective September 2014; therefore, these generating units are not included in the base case. With the Selkirk plant modeled out-of-service, pre-contingency overloads exist on local 115 kV non-BPTF elements beginning in 2015 and, unless resolved, continuing for all study years. There are also significant post-contingency overloads on the local 115 kV transmission lines. Additionally, overloads are noted on the New Scotland 345/115 kV transformer for the loss of generation at Bethlehem followed by loss of a New Scotland 345 kV bus (#77) and the Reynolds 345/115 kV transformer has an N-1-0 violation for the loss of generation at Bethlehem. National Grid is evaluating the overloaded local facilities in this area and determining corrective action plans. The solutions developed by National Grid will impact the magnitude of loadings on BPTF facilities in the Capital Region. These loadings on the BPTF facilities will be reevaluated as part of the CRP following National Grid's update to their local transmission plan.

Lower Hudson Valley & New York City

The UPNY-SENY interface includes five 345 kV lines from north to south within New York: Leeds – Athens – Pleasant Valley (#95/91) 345 kV, Leeds – Pleasant Valley (#92) 345 kV, Leeds – Hurley (#301) 345 kV, Coopers Corners – Rock Tavern (#42) 345 kV, and Coopers Corners – Middletown – Rock Tavern (#34) 345 kV. Similar to the 2012 RNA, the Leeds – Pleasant Valley lines are overloaded starting in 2022 for the N-1-1 loss of other 345 kV lines across the UPNY-SENY interface. These overloads are due to load growth and a reduction in generation in the Lower Hudson Valley and New York City areas.

Table 4-1: 2014 RNA Transmission Security Thermal Violations

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2015 Flow (MVA)	2019 Flow (MVA)	2024 Flow (MVA)	First Contingency	Second Contingency
A	N.Grid	Packard-Huntley (#77) 230 (Packard-Sawyer)	556	644	704			649	Packard-Huntley (#78) 230	SB Robinson Rd 230
A	N.Grid	Packard-Huntley (#78) 230 (Packard-Sawyer)	556	644	746			649	Packard-Huntley (#77) 230	SB Robinson Rd 230
A	N.Grid	Huntley-Gardenville (#79) 230 (Huntley-Sawyer)	566	654	755			664	Huntley-Gardenville (#80) 230	SB Robinson Rd 230
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755		661	672	Huntley-Gardenville (#79) 230	SB Robinson Rd 230
								697	Robinson-Stolle Rd (#65) 230	Huntley-Gardenville (#79) 230
B	RGE	Pannell 345/115 1TR	228	282	336	372			L/O Ginna	SB Pannell 345
B	RGE	Pannell 345/115 2TR	228	282	336	372			L/O Ginna	SB Pannell 345
B	RGE	Pannell-Quaker (#914) 115	207.1	246.9	284.8	298			L/O Ginna	Pannell 345/115 3TR
C	NYSEG	Oakdale 345/115 2TR	428	556	600	573			Watercure 345/230 1TR	SB Oakdale 345
							440	444	Oakdale 345/115 3TR	Base Case
							574	586	Fraser 345/115 2TR	SB Oakdale 345
C	NYSEG	Oakdale 345/115 3TR	428	556	600			438	Oakdale 345/115 2TR	Base Case
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	146	163	168	SB Oswego 345	N/A
							139	142	Elbridge 345/115 1TR	Base Case
						165	204	216	Clay-Woodard (#17) 115	SB Lafayette 345
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	131			Clay-Teall (#11) 115	SB Dewitt 345
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	126			Clay-Dewitt (#13) 345	SB Oswego 345
C	N.Grid	Clay 345/115 1TR	478	637	794		710	757	Oswego-Elbridge-Lafayette (#17) 345	SB Clay 345
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174			183	SB Lafayette 345	N/A
							207	220	Clay-Lockheed Martin (#14) 115	SB Lafayette 345
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104		114	117	Clay 345/115 1TR	SB Clay 345
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	128	141	142	Oswego-Elbridge-Lafayette (#17) 345	SB Clay 345
								143	Clay-Dewitt (#13) 345	SB Oswego 345
E	N.Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)	116	120	145		122	125	Oswego-Elbridge-Lafayette (#17) 345	SB Clay 345
								126	Clay-Dewitt (#13) 345	SB Oswego 345
F	N.Grid	New Scotland 345/115 1TR	458	570	731	631	659	837	L/O Bethlehem	New Scotland (#77) 345
F	N.Grid	Reynolds 345/115	459	562	755	492	498	584	L/O Bethlehem	Base Case
F-G	N.Grid	Leeds-Pleasant Valley (#92) 345	1331	1538	1724			1587	Athens-Pleasant Valley (#91) 345	Tower 41&33
F-G	N.Grid	Athens-Pleasant Valley (#91) 345	1331	1538	1724			1584	Leeds-Pleasant Valley (#92) 345	Tower 41&33

Table 4-2: 2014 RNA Transmission Security Reliability Need Year

Zone	Owner	Monitored Element	Year of Need
B	RGE	Pannell 345/115 1TR	2015
B	RGE	Pannell 345/115 2TR	2015
B	RGE	Pannell-Quaker (#914) 115	2015
C	NYSEG	Oakdale 345/115 2TR	2015
C	N.Grid	Clay-Lockheed Martin (#14) 115	2015
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	2015
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	2015
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	2015
F	N.Grid	New Scotland 345/115 1TR	2015
F	N.Grid	Reynolds 345/115	2015
C	N.Grid	Clay 345/115 1TR	2017
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	2017
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	2017
E	N.Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)	2017
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	2018
C	NYSEG	Oakdale 345/115 3TR	2020
A	N.Grid	Packard-Huntley (#77) 230 (Packard-Sawyer)	2021
A	N.Grid	Packard-Huntley (#78) 230 (Packard-Sawyer)	2021
A	N.Grid	Huntley-Gardenville (#79) 230 (Huntley-Sawyer)	2022
F – G	N.Grid	Leeds-Pleasant Valley (#92) 345	2022
F – G	N.Grid	Athens-Pleasant Valley (#91) 345	2022

4.2.2. Short Circuit Assessment

Performance of a transmission security assessment includes the calculation of symmetrical short circuit current to ascertain whether the circuit breakers in the system could be subject to fault current levels in excess of their rated interrupting capability. The analysis was performed for the year 2019 reflecting the study conditions outlined in Section 3. The calculated fault levels would be constant over the second five years because no new generation or transmission is modeled in the RNA for second five years, and the methodology for fault duty calculation is not sensitive to load growth. The detailed results are presented in Appendix D of this report.

National Grid, having taken into account factors such as circuit breaker age and fault current asymmetry, has derated breakers at certain stations. As a result, overdutied breakers were identified at Porter 230 kV and Porter 115 kV stations. Table 4-3: summarizes over-duty breakers at each station. National Grid reports that plans to make the necessary facility upgrades are in place. For Porter 115 kV, National Grid is scheduled to rebuild the station and replace all the breakers by Winter 2014/2015. For Porter 230 kV, National Grid is scheduled to add microprocessor relays to mitigate the overdutied breakers by the end of 2014.

Table 4-3:2014 RNA Over-Duty Circuit Breaker Summary

Substation	kV	Number of Over-Duty Circuit Breakers	Breaker ID
Porter	115	10	R130, R10, R20, R30, R40, R50, R60, R70, R80, R90
Porter	230	9	R110,R120,R15, R170, R25, R320, R835, R825, R845

4.2.3. Transmission and Resource Adequacy Assessment

The NYISO conducts its resource adequacy analysis with General Electric's Multi Area Reliability Simulation (MARS) software package. The modeling applies interface transfer limits and performs a probabilistic simulation of outages of capacity and transmission resources.

The emergency transfer limits were developed using the 2014 RNA base case. Table 4-4, Table 4-5, and Table 4-6 below provide the thermal and voltage emergency transfer limits for the major NYCA interfaces. For comparison purposes, the 2012 RNA transfer limits are presented.

Table 4-4: Transmission System Thermal Emergency Transfer Limits

	2014 RNA study						2012 RNA study		
Interface	2015	2016	2017	2018	2019	2024	2015	2016	2017
Dysinger East	2200	2150	2100	2075	2050	Same as 2019	2975	2975	2975
Central East MARS	4025	4500	4500	4500	4500	Same as 2019	3425	3425	3475
E to G (Marcy South)	1700	2150	2150	2150	2150	Same as 2019	1700	1700	1700
F to G	3475	3475	3475	3475	3475	Same as 2019	3475	3475	3475
UPNY-SENY MARS	5150	5600	5600	5600	5600	Same as 2019	5150	5150	5150
I to J (Dunwoodie South MARS)	4400	4400	4400	4400	4400	Same as 2019	4400	4400	4400
I to K (Y49/Y50)	1290	1290	1290	1290	1290	Same as 2019	1290	1290	1290

Table 4-5: Transmission System Voltage Emergency Transfer Limits

	2014 RNA study						2012 RNA study		
Interface	2015	2016	2017	2018	2019	2024	2015	2016	2017
Dysinger East	2700	DNC	DNC	DNC	2800	Same as 2019	2875	2900	2875
West Central	1475	DNC	DNC	DNC	1350	Same as 2019	1850	1900	1900
Central East MARS	3250	3100	3100	3100	3100	Same as 2019	3350	3350	3350
Central East Group	4800	5000	5000	5000	5000	Same as 2019	4800	4800	4800
UPNY-ConEd	5210	5210	5210	5210	5210	Same as 2019	5210	5210	5210
I to J & K	5160	5160	5160	5160	5160	Same as 2019	5160	5160	5160

DNC: Did Not Calculate

Table 4-6: Transmission System Base Case Emergency Transfer Limits

	2014 RNA study											2012 RNA study					
Interface	2015		2016		2017		2018		2019		2024	2015		2016		2017	
Dysinger East	2200	T	2150	T	2100	T	2075	T	2050	T	Same as 2019	2875	V	2900	V	2875	V
Central East MARS	3250	V	3100	V	3100	V	3100	V	3100	V	Same as 2019	3350	V	3350	V	3350	V
Central East Group	4800	V	5000	V	5000	V	5000	V	5000	V	Same as 2019	4800	V	4800	V	4800	V
E to G (Marcy South)	1700	T	2150	T	2150	T	2150	T	2150	T	Same as 2019	1700	T	1700	T	1700	T
F to G	3475	T	3475	T	3475	T	3475	T	3475	T	Same as 2019	3475	T	3475	T	3475	T
UPNY-SENY MARS	5150	T	5600	T	5600	T	5600	T	5600	T	Same as 2019	5150	T	5150	T	5150	T
I to J (Dunwoodie South MARS)	4400	T	4400	T	4400	T	4400	T	4400	T	Same as 2019	4400	T	4400	T	4400	T
I to K (Y49/Y50)	1290	T	1290	T	1290	T	1290	T	1290	T	Same as 2019	1290	T	1290	T	1290	T
I to J & K	5160	C	5160	C	5160	C	5160	C	5160	C	Same as 2019	5160	C	5160	C	5160	C

Note: T=Thermal, V=Voltage, C=Combined

The Dysinger East transfer limit decreased compared to the transfer limit used in the 2012 RNA. The thermal limitations on the 230 kV transmission path between Packard and Gardenville in Zone A became more constraining than the voltage limitations. This was due primarily to modeling the Dunkirk plant as out-of-service in the 2014 RNA analysis whereas, in contrast, there was 500 MW of generic generation modeled at the Dunkirk substation for the calculation of transfer limits in the 2012 RNA. The transfer limit further reduces incrementally each year due to load growth in Zone A.

The Central East MARS interface limit is lower for the 2014 RNA than it was for the 2012 RNA. This is primarily due to the inclusion of the Transmission Owner Transmission Solutions (TOTS) projects. The inclusion of the TOTS projects in the model also resulted in increases to the Central East Group, Marcy South, and UPNY-SENY MARS interface transfer limits. The TOTS projects that add series compensation to the Marcy South transmission corridor effectively increase flow through that transmission path. The second Rock Tavern-Ramapo 345 kV line also contributes to this change in the power flow pattern. The result is that power is diverted somewhat from the circuits that make up the Central East MARS interface and the power flow across the UPNY-SENY interface is more balanced between the Marcy South corridor and the Leeds-Pleasant Valley corridor. Inclusion of the TOTS projects also impacts the A line and VFT interface(Staten Island) by significantly reducing the constraints on flows from Staten Island generation and the ties to New Jersey.

The results of the 2014 RNA base case studies show that the LOLE for the NYCA exceeds 0.1 beginning in the year 2019 and the LOLE continues to increase through 2024[2]. The LOLE results for the entire 10-year RNA base case are presented in Table 4-7. While the LOLE criteria are evaluated on a statewide basis, both the NYCA and zonal LOLE are presented for informational purposes to assist in the development of the compensatory MWs. The zonal LOLE are driven by many factors and thus cannot be used for direct identification of the drivers of the statewide LOLE violations. A test to determine the causation of the LOLE separation on a zonal basis caused by transmission interface constraints was developed and applied to identify those interfaces most binding at the time of NYCA LOLE event. It is referred to as the Binding Interface test and it is critical in developing the most effective compensatory MW locations. Consistent with the previous RNAs, UPNY-SENY remains the most constraining interface.

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[2] RNA Study results are rounded to two decimal places. A result of exactly 0.01, for example, would correspond to one event in one hundred years.

Table 4-7: NYCA Resource Adequacy Measure (in LOLE)

Zone(s)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Zone A	0	0	0	0	0	0	0	0	0	0
Zone B	0.02	0.02	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.09
Zone C	0	0	0	0	0	0	0	0	0	0
Zone D	0	0	0	0	0	0	0	0	0	0
Zone E	0.02	0.02	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.09
Zone F	0	0	0	0	0	0	0	0	0	0
Zones A-F	0.02	0.02	0.04	0.05	0.06	0.06	0.07	0.08	0.08	0.09
Zone G	0.01	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.08
Zone H	0	0	0	0	0	0	0	0	0	0
Zone I	0.04	0.04	0.06	0.08	0.11	0.13	0.15	0.18	0.22	0.25
Zone J	0.04	0.04	0.06	0.08	0.10	0.12	0.15	0.18	0.21	0.25
Zone K	0.01	0.02	0.03	0.04	0.06	0.07	0.09	0.12	0.15	0.19
Zones G-K	0.04	0.04	0.06	0.08	0.11	0.13	0.15	0.18	0.22	0.26
NYCA	0.04	0.04	0.06	0.08	0.11	0.13	0.15	0.18	0.22	0.26

*Note: "0" represents an LOLE less or equal to 0.004.

In order to avoid over-dependence on emergency assistance from external areas, emergency operating procedures in the external areas are not modeled. Capacity of the external systems is further adjusted so that the interconnected LOLE value of the external areas (Ontario, New England, Hydro Quebec, and PJM) is not less than 0.10 and not greater than 0.15 for the year 2015. The level of load and generation are frozen in the remaining years. The LOLE for the external systems will generally increase consistent with the increase in NYCA LOLE which results from the load growth over the Study Period. The increase is higher than in previous RNAs because of the increased binding on Dysinger East and Central East Group.

4.2.4. System Stability Assessment

The 2010 NYISO Comprehensive Area Transmission Review (CATR), which was completed in June 2011 and evaluated the year 2015, is the most recent CATR. The 2013 NYISO Intermediate Area Transmission Review evaluated the year 2018 and was completed in June 2014. The stability analyses conducted as part of the 2010 and 2013 ATRs in conformance with the applicable NERC standards, NPCC criteria, and NYSRC Reliability Rules found no stability issues (criteria violations) for summer peak load and light load conditions.

4.3. Reliability Needs Summary

After determining that the LOLE criterion would be violated beginning in 2019 and continuing through 2024, the LOLE for the bulk power system for those years was calculated with two additional cases. The first is NYCA Thermal with all NYCA internal transfer limits set at thermal (not voltage) limits to determine whether the system was adequate to deliver generation to the loads without the voltage constraints. The second is the NYCA free flow, which was performed with all NYCA internal transfer limits removed. Table 4-8 presents a summary of the results.

Table 4-8: Summary of the LOLE Results – Base, Thermal, and Free Flow Cases

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
NYCA	0.04	0.04	0.06	0.08	0.11	0.13	0.15	0.18	0.22	0.26
NYCA Thermal	0.04	0.04	0.06	0.08	0.11	0.13	0.15	0.18	0.22	0.26
NYCA FreeFlow					0.07	0.07	0.07	0.08	0.08	0.09

In general, an LOLE result above 0.1 days per year indicates that additional resources are required to maintain reliability (adequacy). The results indicate the first year of need for resources (a Reliability Need) is 2019 for the RNA base case. The Reliability Needs can be resolved by adding capacity resources downstream of the transmission constraints or by adding transmission reinforcement to mitigate the constraints.

To determine if transmission reinforcements would be beneficial, the "NYCA Thermal" and a "NYCA Free Flow Test" cases are executed. The first year of need for the free flow sensitivity case is beyond 2024, which means that there is no statewide deficiency, and transmission reinforcement is a potential option to resolving the LOLE violation. In addition, the NYCA Thermal case results indicate that voltage limits are not constraining enough to impact NYCA LOLE.

Additional analysis of the base case results to determine binding hours showed that UPNY-SENY remains among the most constraining interfaces, consistent with the conclusion from the previous RNAs. This indicates that increasing the total resources downstream of UPNY-SENY or increasing the UPNY-SENY transfer limit will be among the most effective options to resolve the LOLE violations. Another aspect of the binding hours determination is to perform a relaxation by increasing the individual constraint limits, one at a time. Increasing the limit on UPNY-SENY by 1,000 MW showed the most movement in NYCA LOLE and the individual Load Zone LOLE. Zonal LOLE went down for all Zones G-K. This test further indicates the potential of transmission reinforcements and gives valuable insight to the most effective locations for the Compensatory MW development shown in Section 4.3.

Compensatory MW

To provide information to the marketplace regarding the magnitude of the resources that are required to meet the BPTF transmission security needs, Table 4-9 contains a summary of the minimum compensatory MW to satisfy the transmission security violations identified in Section 4.2.1.

The compensatory MW identified in Table 4-9 are for illustrative purposes only and are not meant to limit the specific facilities or types of resources that may be offered as Reliability Needs solutions. Compensatory MW may reflect generation capacity (MVA), demand response, or transmission additions.

Table 4-9: Compensatory MW Additions for Transmission Security Violations

Zone	Owner	Monitored Element	2015 MVA Overload	2015 Min. Comp. MW	2019 MVA Overload	2019 Min. Comp. MW	2024 MVA Overload	2024 Min. Comp. MW
A	N.Grid	Packard-Huntley (#77) 230 (Packard-Sawyer)					5	7
A	N.Grid	Packard-Huntley (#78) 230 (Packard-Sawyer)					5	7
A	N.Grid	Huntley-Gardenville (#79) 230 (Huntley-Sawyer)					10	12
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)			7	9		
							43	51
B	RGE	Pannell 345/115 1TR	90	295				
B	RGE	Pannell 345/115 2TR	90	295				
B	RGE	Pannell-Quaker (#914) 115	49	86				
C	NYSEG	Oakdale 345/115 2TR	17	34				
					12	23	16	30
					18	34	30	56
C	NYSEG	Oakdale 345/115 3TR					10	19
C	N.Grid	Clay-Lockheed Martin (#14) 115	26	35	46	61	48	64
					28	38	32	43
			45	61	84	114	96	130
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	11	15				
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	6	8				
C	N.Grid	Clay 345/115 1TR			73	182	120	299
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)					9	15
					33	54	46	75
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)			10	17	13	22
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	7	10	21	30		
							23	33
E	N.Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)			2	3		
							6	8
F	N.Grid	New Scotland 345/115 1TR	61	141	89	205	267	612
F	N.Grid	Reynolds 345/115	33	109	39	128	125	427
F-G	N.Grid	Leeds-Pleasant Valley (#92) 345					49	160
F-G	N.Grid	Athens-Pleasant Valley (#91) 345					46	152

For resource adequacy deficiencies, the amount and location of the compensatory MW is determined by testing combinations of capacity resources (representing blocks of 50MW of UCAP) located in various load zones until the NYCA LOLE is reduced to 0.1 days per year or less. The process of calculating compensatory MW values informs developers and policy makers by allowing them to test all resource types in meeting needs, by providing additional information on binding interfaces, and allows for the iterative testing of resources in various locations to meet system needs. The purpose of the analyses is not only to show the level of compensatory MW needed to meet the LOLE criterion, but also the importance of the location chosen for the compensatory MW. The results of the MARS simulations for the RNA base case, and scenarios provide information that can be used to guide the compensatory MW analyses as well. If an LOLE violation is, to some extent, caused by a frequently constrained interface, locating compensatory MW upstream of that load zone will result in a higher level of required compensatory MW to meet resource adequacy requirements. The location of these compensatory MW assumes that there are no impacts on internal zonal constraints or the present interface limits into or out of the Zone(s) being tested. These impacts will be determined for the solutions that will be evaluated in the CRP.

Not all alternatives tested were able to achieve an LOLE of less than or equal to 0.1 days per year. The results of the compensatory MW calculation show that by 2024, a total of 1,150 MW are required to mitigate the reliability criteria violations in the base case.

Table 4-10: Compensatory MW Additions for Resource Adequacy Violations

Year	Zones for Additions			
	Only in ABCEF	Only in G-K	Only in J	Only in K
2015	-	-	-	-
2016	-	-	-	-
2017	-	-	-	-
2018	-	-	-	-
2019	400	100	100	100
2020	3,900	300	300	300
2021	5,600	500	500	500
2022	7,400	700	700	800
2023	not feasible	950	950	1,100
2024	not feasible	1,150	1,150	1,500

Review of the results indicates that adequate compensatory MW must be located within Zone G through K because of the existing transmission constraints into those Zones. Potential solutions could include a combination of additional transfer capability into Zones G through K from outside those zones and/or resources located within Zones G through K. Further examination of the results reveals that the constraining hours of UPNY-SENY and Dysinger East are increasing over the Study Period. Binding hours for interface below UPNY-SENY are not that significant in 2024 for the base case, but would increase greatly if significant resources are added exclusively to Zone K.

These results indicate that the total amount of compensatory MW could be located anywhere within SENY; no individual zone has a unique requirement. Although the effectiveness of compensatory MW located in Zones A through F and Zone K diminishes as the transmission constraints to the deficient zones become more binding, these compensatory MW will help to mitigate the statewide LOLE violations. Compensatory MW located in Zones A through F, and assuming equal distribution, is only reasonably effective for 2019, and even then would require four times as much MW to be as effective. The effectiveness diminishes rapidly for future years and becomes non feasible in 2023. For Zone K, the compensatory MW would be as effective up to 500 MW to the year 2021, with a reduction in effectiveness of approximately thirty percent in 2024. The NYISO will evaluate proposed solutions effectiveness in mitigating LOLE violations and any impacts on transfer limits during the development of the 2014 CRP. There are other combinations of compensatory MW that would also meet the statewide reliability criteria, but it is not the intent of this analysis to identify preferred locations or combinations for potential solutions.

The regulated backstop solutions may take the form of alternative solutions of possible resource additions and system changes. Such proposals will provide an estimated implementation schedule so that trigger dates could be determined by the NYISO for purposes of beginning the regulatory approval and development processes for the regulated backstop solutions if market solutions do not materialize in time to meet the reliability needs.

4.4. Dunkirk Plant Fuel Conversion Sensitivity

The Dunkirk plant sensitivity evaluates the NYCA system using the base case assumptions, with the added assumption that the proposed fuel conversion of Dunkirk units #2, #3, and #4, a total of 435 MW, from coal to natural gas is completed prior to summer 2016.

The impact of Dunkirk generation returning to service on the NYCA BPTF[3] was assessed in this sensitivity analysis. The availability of Dunkirk after the fuel conversion project relieves the transmission security thermal violations in Buffalo and Binghamton areas.

The transmission security analysis with Dunkirk not in-service continues to identify several thermal violations on the BPTF for N-1, N-1-0, and N-1-1 conditions under 50/50 coincident peak load forecast conditions. With Dunkirk in-service, the thermal violations observed in the RNA base case in the Western New York region and the Binghamton Area (Oakdale 345/230/115 kV substation) are resolved. In the Central region the overloads observed in the Oswego, Utica, and Syracuse areas are reduced, but not resolved with Dunkirk in-service due to a higher west to east flow, but require further system changes to resolve the overloads. The Capital and Southeast regions are insignificantly impacted with Dunkirk in-service. The voltage violations observed in the RNA base case in the Binghamton and Utica areas are not resolved with Dunkirk in-service because Dunkirk is too far removed geographically to have any substantial effect on these violations.

Table 4-11 provides a summary of the contingency pairs with Dunkirk in-service that result in the highest thermal overload on each violated BPTF element in the Central region under N-1, N-1-0, and N-1-1 conditions under 50/50 coincident peak load conditions. In the second contingency column of Table 4-11, "N/A" corresponds to an N-1 violation and "Base Case" corresponds to an N-1-0 violation. Considering non-coincident zonal peak loading, the overloads listed in Table 4-11 can increase, most notably in the out-years.

[3] The local transmission projects are modeled appropriately according to PSC Case 12-E-0577 – Proceeding on Motion of the Commission to Examine Repowering Alternatives to Utility Transmission Reinforcements – Materials Presented at October 31, 2013 Technical Conference, presented by National Grid.

Table 4-11: 2014 RNA 50/50 Forecast Transmission Security Thermal Violations with Dunkirk In-Service

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2019 Flow (MVA)	2024 Flow (MVA)	Dunkirk In-Service	
								First Contingency	Second Contingency
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	155	160	SB Oswego 345	N/A
						128	131	OS-EL-Lafayette (#17) 345	Base Case
						184	190	Clay-Wood (#17) 115	SB Oswego 345
C	N.Grid	Clay 345/115 1TR	478	637	794	698	723	OS-EL-Lafayette (#17) 345	SB Clay 345
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	183	194	Clay-Lockheed Martin (#14) 115	SB Lafayette 345
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	112	113	Clay 345/115 1TR	SB Clay 345
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	135	137	OS-EL-Lafayette (#17) 345	SB Clay 345

For resource adequacy assessment, dynamic limit tables are implemented on two interfaces, Dysinger East and Zone A Group, and the details are included in Appendix D. Starting in 2019, NYCA LOLE exceeds 0.1, and the return of Dunkirk to service following its fuel conversion does not change the Need Year.

4.5. Scenarios

The NYISO develops reliability scenarios pursuant to Section 31.2.2.5 of Attachment Y of the OATT. Scenarios are variations on the RNA base case to assess the impact of possible changes in key study assumptions which, if they occurred, could change the timing, location or degree of Reliability Criteria violations on the NYCA system during the study period. The following scenarios were evaluated as part of the RNA:

- High Load (Econometric) Forecast (impacts associated with projected energy reductions produced statewide)
- Transmission security assessment using a 90/10 load forecast
- Zonal Capacity at Risk
- Indian Point Plant Retirement assessment
- Stressed Winter Condition assessment

4.5.1. High Load (Econometric) Forecast

The RNA base case forecast includes impacts associated with projected energy reductions coming from statewide energy efficiency and retail PV programs. The High Load Forecast Scenario excludes these energy efficiency program impacts from the peak forecast, resulting in the econometric forecast levels, and is shown in Table 3-2. This results in a higher peak load in 2024 than the base case forecast by 2,079 MW. Given that the peak load in the econometric forecast is higher than the base case, the probability of violating the LOLE criterion increases with violations also occurring at any earlier point in time.

The results indicate the LOLE would be 0.08 in 2016 and would increase to 0.13 by 2017 under the high load scenario. If the high load forecast were to materialize, the year of need for resource adequacy would be advanced by two years from 2019 in the base case to 2017 in the high load scenario. The horizon year, 2024, LOLE would increase from 0.26 to 0.81 absent system changes to resolve violations in earlier years.

4.5.2. Zonal Capacity at Risk

The base case LOLE does not exceed 0.10 until 2019. Scenario analyses were performed to determine the reduction in zonal capacity (i.e., the amount of capacity in each zone that could be lost) which would cause the NYCA LOLE to exceed 0.10 in each year from 2015 through 2018. The NYISO reduced zonal capacity to determine when violations occur in the same manner as the compensatory MW are added to mitigate resource adequacy violations, but with the opposite impact. The zonal capacity at risk analysis is summarized in Table 4-12.

Table 4-12: Zonal Capacity at Risk (MW)

	2015	2016	2017	2018
Zone A	1,550	1,750	1,450	750
Zone B	exceeds zonal resources	exceeds zonal resources	exceeds zonal resources	450
Zone C	2,200	1,850	1,100	450
Zone D	exceeds zonal resources	exceeds zonal resources	1,100	450
Zone E	exceeds zonal resources	exceeds zonal resources	exceeds zonal resources	500
Zone F	1,800	1,700	1,050	450
Zones A-F	2,500	2,200	1,300	550
Zone G	650	750	400	150
Zone H	650	750	400	150
Zone I	N/A	N/A	N/A	N/A
Zones G-I	650	750	400	150
Zone J	650	750	400	150
Zone K	550	550	350	150

The zones at risk analyses identify a maximum level of capacity that can be removed without causing LOLE violations. However, the impact of removing capacity on the reliability of the transmission system and the transfer capability are highly location dependent. Thus, in reality, lower amounts of capacity removal are likely to result in reliability issues at specific transmission locations. The study did not attempt to assess a comprehensive set of potential scenarios that might arise from specific unit retirements. Therefore, actual proposed capacity removal from any of these zones would need to be further studied in light of the specific capacity locations in the transmission network to determine whether any additional violations of reliability criteria would result. Additional transmission security analysis, such as N-1-1 analysis, would need to be performed for any contemplated plant retirement in any zone.

4.5.3. Indian Point Retirement Assessment

Because its owners submitted license renewal applications on a timely basis, the Indian Point Plant is authorized to continue operations throughout its currently ongoing license renewal processes. This scenario studied the impacts if the Indian Point Plant were instead to be retired by the end of 2015 (the later of the two current license expiration dates). Significant violations of transmission security and resource adequacy criteria would occur in 2016 if the Indian Point Plant were to be retired as of that time. These results were determined using the base case assumptions with the additional change that the Con Edison load was modified to incorporate 125 MW of targeted load reduction projects, consisting of 100 MW of Energy Efficiency and Demand Reduction, and 25 MW of Combined Heat and Power distributed generation.

The Indian Point Plant has two base-load units (2,060 MW total) located in Zone H in Southeastern New York, an area of the State that is subject to transmission constraints that limit transfers in that area as demonstrated by the reliability violations that arise by 2019 in the base case. Southeastern New York, with the Indian Point Plant in service, currently relies on transfers to augment existing capacity. Consequently, load growth or loss of generation capacity in this area would aggravate constraints.

The transmission security analysis has not materially changed since the 2012 RNA regarding the need year under the Indian Point retirement scenario. The results showed that the shutdown of the Indian Point Plant exacerbates the loading across the UPNY-SENY interface, with the Leeds – Pleasant Valley and Athens – Pleasant Valley 345 kV lines above their LTE ratings in 2016.

Using the base case load forecast adjusted for the Con Edison EE program, LOLE is 0.31 in 2016 with Indian Point Plant retired, which is a substantial violation of the 0.1 days per year criterion. Beyond 2016, the LOLE continues to escalate due to annual load growth for the remainder of the Study Period reaching an LOLE of 1.17 days per year in 2024. The NYCA LOLE is summarized in Table 4-13 below.

Table 4-13: Indian Point Plant Retirement LOLE Results

Indian Point Plant Retirement	2016	2017	2018	2019	2020	2021	2022	2023	2024
NYCA LOLE	0.31	0.40	0.40	0.59	0.67	0.76	0.89	1.03	1.17

Compared with 2012 RNA, the resulting LOLE violations are lower, but continue to substantially exceed the LOLE requirement should the Indian Point Plant retire. Note that with the large loss of capacity, the LOLE violations increase exponentially. Other factors, such as Transmission Owner Transmission Solutions (TOTS), decrease the impact of the loss of capacity, but will not solve the violations.

4.5.4. Transmission Security Assessment Using 90/10 Load Forecast

The 90/10 peak load forecast represents an extreme weather condition (e.g. hot summer day). Table 4-14 provides a summary of the 90/10 coincident peak load forecast through the ten-year study period compared to the total resources modeled as available, resulting in the total remaining resources on a year-by-year basis. The resource totals include net purchases and sales, and all available thermal and large hydro units are modeled at 100% of their summer capability. Derates to small hydro, wind, and solar PV are applied consistent with the transmission security base case assumptions.

As shown in Table 4-14, based on the assumptions applied in this analysis, beginning in 2017 there are insufficient resources to meet the minimum 10-minute operating reserve requirement of 1,310 MW[4]. Due to insufficient generation represented in the power flow case

[4] New York State Reliability Council, "NYSRC Reliability Rules for Planning and Operating the New York State Power System", Version 33, dated April 10, 2014

to meet the minimum operating reserve, loss of source contingencies are not studied in the 2019 case. Starting in 2020, there are insufficient resources to meet the modeled 90/10 peak load; therefore, a transmission security assessment was not performed under 90/10 conditions in the 2024 case. In 2015, there are sufficient resources to meet the minimum operating reserve, and thus, all design criteria contingencies are evaluated.

Table 4-14: 90/10 Peak Load Forecast NYCA Remaining Resources (MW)

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total Resources*	38,313	38,332	38,017	38,017	38,017	38,017	38,017	38,017	38,017	38,017
90/10 Peak Load Forecast	36,397	36,764	37,142	37,506	37,870	38,089	38,338	38,592	38,850	39,073
Remaining Resources	1,916	1,568	875	511	147	-72	-321	-575	-833	-1,056

* Total resources include NYCA generation and net purchases & sales. Assumes 100% availability of thermal and large hydro units; small hydro, wind and solar PV are derated.

The four primary regions of Reliability Needs due to transmission security violations identified in the RNA base case are exacerbated under 90/10 coincident peak load conditions. Table 4-15 provides a summary of the contingency pairs that result in the highest thermal overload on BPTF elements that are not observed under 50/50 coincident peak load conditions. Table 4-16 shows that increased load growth across the state exacerbates the violations identified in the RNA base case. These reliability needs are generally driven by recent and proposed generator retirements/mothballs combined with higher levels of load growth. For both tables, in the second contingency column "N/A" corresponds to a violation occurring under N-1 conditions and "Base Case" corresponds to a violation under an N-1-0 conditions.

While the 90/10 peak load forecast does result in additional overloads, those overloads occur in the same four primary regions of Reliability Needs identified in the 50/50 peak load base case. As shown in Table 4-16, the increased peak load would also result in the earlier occurrence of the Reliability Needs identified in the 50/50 peak load base case. Although the Leeds – Pleasant Valley 345 kV lines are not overloaded in 2015 under the conditions studied, those lines are loaded to 98% of the LTE rating under 90/10 peak load N-1-1 conditions. Any significant reduction of generation or imports in Southeast New York in 2015 would result in an overload on Leeds – Pleasant Valley 345 kV for the evaluated 90/10 peak load conditions.

Table 4-15: 90/10 Transmission Security Violations Not Observed Under 50/50 Load Conditions

Zone	Owner	Monitored Element (kV)	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2015 Flow (MVA)	2019 Flow (MVA)	First Contingency (kV)	Second Contingency (kV)
A	N.Grid	Niagara-Packard (#61) 230	620	717	841		738	Oswego-Volney (#12) 345	T:62&BP76
A	N.Grid	Niagara-Packard (#62) 230	620	717	841		801	Oswego-Volney (#12) 345	T:61&64
A	N.Grid	Niagara 230/115 AT2	192	239	288		264	Niagara-Packard (#61) 230	SB Packard 230
B	RGE	Pannell 345/115 3TR	255	319	336	258		L/O Ginna	Base Case
B	RGE	Station 82-Mortimer 115	258.1	357.9	410.4	277		Niagara-Robinson Rd (#64) 345	Base Case
						388		L/O Ginna	SB Pannell 345
B	RGE	Station 80 345/115 2TR	330	415	478	444		Station 80 345/115 5TR	SB Station 80 345
B	RGE	Station 80 345/115 5TR	462	567	630	636		Station 80 345/115 2TR	SB Station 80 345
C	N.Grid	Clay 345/115 2TR	478	637	794		695	Clay 345/115 1TR	SB Oswego 345
C	N.Grid	Clay-Dewitt (#3) 115 (Bartell Rd-Pine Grove)	116	120	145	138		Clay-Dewitt (#13) 345	SB Oswego 345
C	N.Grid	Clay-Woodard (#17) 115 (Clay-Euclid)	220	252	280		260	Clay-Lockheed Martin (#14) 115	SB Lafayette 345
C	N.Grid	Clay-Lighthouse Hill (#7) 115 (Lighthouse Hill-Mallory)	108	108	108		123	Clay 345/115 1TR	SB Clay 345
C	NYSEG	Watercure 345/230 1TR	440	540	600	568		Oakdale 345/115 2TR	SB Oakdale 345
E	N.Grid	Porter-Yahnundasis (#3) 115 (W. Utica-Walesville)	116	120	145		123	Clay-Dewitt (#13) 345	SB Oswego 345

Table 4-16: 50/50 Transmission Security Violations Exacerbated Under 90/10 Load Conditions

Zone	Owner	Monitored Element (kV)	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	2015 Flow (MVA)	2019 Flow (MVA)	First Contingency (kV)	Second Contingency (kV)
A	N.Grid	Packard-Huntley (#77) 230 (Packard-Sawyer)	556	644	704		663	Packard-Huntley (#78) 230	SB Robinson Rd. 230
A	N.Grid	Packard-Huntley (#78) 230 (Packard-Sawyer)	556	644	746	645	663	Packard-Huntley (#77) 230	SB Robinson Rd. 230
A	N.Grid	Huntley-Gardenville (#79) 230 (Huntley-Sawyer)	566	654	755	661	672	Huntley-Gardenville (#80) 230	SB Robinson Rd. 230
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755		662	Huntley-Gardenville (#79) 230	N/A
							568	Huntley-Gardenville (#79) 230	Base Case
						692		Robinson Rd.-Stolle Rd. (#65) 230	Huntley-Gardenville (#79) 230
							716	Stolle Rd.-Gardenville (#66) 230	Huntley-Gardenville (#79) 230
B	RGE	Pannell 345/115 1TR	228	282	336	247		L/O Ginna	Base Case
						414		L/O Ginna	SB Pannell 345
B	RGE	Pannell 345/115 2TR	228	282	336	247		L/O Ginna	Base Case
						414		L/O Ginna	SB Pannell 345
							293	Station 80-Pannell (RP-1) 345	SB Pannell 345
B	RGE	Pannell-Quaker (#914) 115	207.1	246.9	284.8	316		L/O Ginna	Pannell 345/115 3TR
C	NYSEG	Oakdale 345/115 2TR	428	556	600		583	SB Oakdale 345	N/A
						478	491	Oakdale 345/115 3TR	Base Case
						637	688	Fraser 345/115 2TR	SB Oakdale 345
C	NYSEG	Oakdale 345/115 3TR	428	556	600	472	484	Oakdale 345/115 2TR	Base Case
						618		Watercure 345/115 1TR	SB Oakdale 345
							587	Oakdale 345/115 2TR	SB Oakdale 345
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	162	184	SB Oswego 345	N/A
						134	161	Elbridge 345/115 1TR	Base Case
						198	234	Clay-Wood (#17) 115	SB Lafayette 345
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	149		Clay-Dewitt (#13) 345	SB Oswego 345
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	151		Clay-Dewitt (#13) 345	SB Oswego 345
C	N.Grid	Clay 345/115 1TR	478	637	794	736		Oswego-Elbridge-Lafayette (#17) 345	SB Clay 345
			478	637	794		778		
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174		200	SB Lafayette 345	N/A
						201	240	Clay-Lockheed Martin (#14) 115	SB Lafayette 345
C	N.Grid	Clay-S. Oswego (#4) 115 (S. Oswego-Whitaker)	104	104	104	120	121	Clay 345/115 1TR	SB Clay 345
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	123	132	SB Oswego 345	N/A
							129	Porter-Oneida (#7) 115	Base Case
						147	155	Clay-Dewitt (#13) 345	SB Oswego 345
E	N.Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)	116	120	145	129	140	Clay-Dewitt (#13) 345	SB Oswego 345
F	N.Grid	New Scotland 345/115 1TR	458	570	731	707		L/O Bethlehem	New Scotland 345/115 2TR
F	N.Grid	Reynolds 345/115	459	562	755	562		L/O Bethlehem	Base Case
F-G	N.Grid	Leeds-Pleasant Valley (#92) 345	1331	1538	1724		1711	Athens-Pleasant Valley (#91) 345	T:41&33
F-G	N.Grid	Athens-Pleasant Valley (#91) 345	1331	1538	1724		1695	Leeds-Pleasant Valley (#92) 345	T:41&33

4.5.5. Stressed Winter Condition Assessment

Five major cold snaps were experienced during the 2013-2014 winter season, including three polar vortex events that chilled large swaths of the Eastern Interconnection and the remainder of the United States. During this time the NYISO set a new winter peak of 25,738 MW while neighboring ISOs and utilities concurrently set their own record winter peaks during the month of January as well. The extreme winter weather conditions resulted in high load conditions, transmission and generation derates, and gas pipeline constraints.

The widespread impact reduced the ability of neighboring areas to provide assistance to New York. Highlights of the peak day recorded on January 7, 2014 follow:

- On January 7, the NYISO set a new record winter peak load of 25,738 MW[5].
- 25,541 MW -- Prior record winter peak load set in 2004
- 24,709 MW -- "50/50" forecast winter peak for 2013-14
- 26,307 MW -- "90/10" forecast winter peak for 2013-14
- Many other ISOs and utilities set record Winter Peaks, including PJM, MISO, TVA, and Southern Company; although NYCA did not lose the ability to provide and receive emergency assistance from neighboring pools. The record shows that NYCA exported power to PJM while importing from HQ, ISO-NE and IESO.
- The NYISO experienced 4,135 MW of generator derates over the peak hour.
- The NYISO activated demand response resources on a voluntary basis in all zones to maintain operating reserve criteria; however, because the 21-hour prior notification was not provided demand response participation was limited.
- The NYISO issued a NERC Energy Emergency Alert 1 indicating that the NYISO was just meeting reserve requirements.
- The NYISO issued public appeals for customers to curtail non-essential use.

Based upon this experience, the scenario was constructed to gauge the amount of capacity that could be lost from the NYCA while restricting the ability to receive assistance from our neighbors. Capacity was removed from all NYCA zones proportional to zonal capacity at each external assistance level until an annual LOLE violation was observed for the year. Additionally, the hourly loads in the MARS model for the month of January 2015 were modified to reflect actual January 2014 loads for all three input load shapes. The experienced January 2014 peak was normalized to 50/50 conditions and the load forecast uncertainty (LFU) bins for winter conditions were updated for the MARS model. These values are shown in Table 4-17.

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[5] This value is the actual load prior to adjustment for demand response that was activated at the time of the system winter peak.

Table 4-17: Derivation of 2014 NYCA Winter LFU

Zones	Bin 1	Bin 2	Bin 3	Bin 4	Bin 5	Bin 6	Bin 7
A	1.136	1.090	1.045	1.000	0.955	0.910	0.864
B	1.135	1.090	1.045	1.000	0.955	0.910	0.865
C	1.136	1.091	1.045	1.000	0.955	0.909	0.864
D	1.170	1.113	1.057	1.000	0.943	0.887	0.830
E	1.136	1.091	1.045	1.000	0.955	0.909	0.864
F	1.136	1.090	1.045	1.000	0.955	0.910	0.864
G	1.136	1.090	1.045	1.000	0.955	0.910	0.864
H	1.158	1.105	1.053	1.000	0.947	0.895	0.842
I	1.158	1.105	1.053	1.000	0.947	0.895	0.842
J	1.158	1.105	1.053	1.000	0.947	0.895	0.842
K	1.180	1.120	1.060	1.000	0.940	0.880	0.820
NYCA	1.151	1.101	1.051	1.000	0.949	0.899	0.849
Probability	0.0062	0.0606	0.2417	0.383	0.2417	0.0606	0.0062

In order to model a statewide LOLE violation in 2015, the annual LOLE of 0.06, as observed in Table 4-7, was subtracted from the reliability criterion level of 0.1 days/yr to reach a target LOLE of 0.04 for this scenario. January 2015 was then simulated with multiple levels of NYCA capacity loss and external import capability reduction until the target January LOLE was observed.

Many factors can impact the emergency assistance from neighboring control areas; therefore a simple approach was adopted and applied to this scenario. By creating a NYCA import interface that was defined as encircling all of NYCA, it became possible to limit the external import capability by defining a MW flow limit. In the conservative case that NYCA is unable to receive emergency assistance from any of the neighboring areas, it would take a capacity loss of 7,250 MW of resources in an extreme weather condition to result in an annual LOLE violation in year 2015.

Table 4-18: Simultaneous NYCA Import Limits and MW Lost in Stressed Winter Scenario

Limit (MW)	MW Lost
4,000	11,300
2,000	9,300
0	7,250

5. Impacts of Environmental Regulations

5.1. Regulations Reviewed for Impacts on NYCA Generators

The 2012 RNA identified new environmental regulatory programs that could impact the operation of the Bulk Power Transmission Facilities. These state and federal regulatory initiatives cumulatively will require considerable investment by the owners of New York's existing thermal power plants in order to comply. The following programs are reviewed in the 2014 RNA:

a) *NOx RACT*: Reasonably Available Control Technology (Effective July 2014)

b) *BART*: Best Available Retrofit Technology for regional haze (Effective January 2014)

c) *MATS*: Mercury and Air Toxics Standard for hazardous air pollutants (Effective April 2015)

d) *MRP*: Mercury Reduction Program for Coal-Fired Electric Utility Steam Generating Units – Phase II reduces Mercury emissions from coal fired power plants in New York beginning January 2015

e) *CSAPR*: Cross State Air Pollution Rule for the reduction of SO2 and NOx emissions in 28 Eastern States. The U.S. Supreme Court has upheld the CSAPR as promulgated by USEPA. The Supreme Court remanded the rule to the District Circuit Court of Appeals for further proceedings, and eventual implementation by the USEPA.

f) *CAIR*: Clean Air Interstate Rule will continue in place until CSAPR is implemented

g) *RGGI*: Regional Greenhouse Gas Initiative Phase II cap reductions started January 2014

h) *CO2 Emission Standards*: NSPS scheduled to become effective June 2014, Existing Source Performance Standards may be effective in 2016

i) *RICE*: NSPS and NESHAP – New Source Performance Standards and Maximum Achievable Control Technology for Reciprocating Internal Combustion Engines (Effective July 2016).

j) *BTA*: Best Technology Available for cooling water intake structures (Effective upon Permit Renewal)

The NYISO has determined that as much as 33,200 MW in the existing fleet (88% of 2014 Summer Capacity) will have some level of exposure to the new regulations.

5.1.1. Reasonably Available Control Technology for NOx (NOx RACT)

The NYSDEC has promulgated revised regulations for the control of Nitrogen Oxides (NOx) emissions from fossil-fueled electric generating units. These regulations are known as NOx RACT (Reasonably Available Control Technology). In New York, 221 units with 27,100 MW of capacity are affected. The revised emission rate limits become effective on July 1, 2014.

There are three major NOx RACT System Averaging "bubbles" in Zone J: TC Ravenswood (TCR Bubble), NRG Arthur Kill- Astoria Gas Turbines (NRG Bubble), and USPowerGen Astoria-Narrows and Gowanus Gas Turbines (USPowerGen Bubble). Historically the boilers have demonstrated the ability to operate at emission rates that are below the presumptive emission rates in the NOx RACT regulation. On the other hand, the older gas turbines in Zone J frequently operate at emission rates in excess of the presumptive limits. With planning and careful operation, the units within the bubbles can be operated in a manner such that the higher emission rates from the gas turbines can be offset by the lower emission rates from the boilers. Table 5-1 below has the presumptive NOx RACT emission limits that were in effect until June 30, 2014. Table 5-2 has the new presumptive emission limits effective starting from July 1, 2014. The emission limits for the gas turbines remain unchanged. It is apparent that the ability of the boilers to offset emissions from the gas turbines will be significantly reduced with the new limits.

Table 5-1: NOx RACT Limits Effective until June 30, 2014

Fuel Type	Boiler Type (Pounds/mmBTU or #/mmBTU)			
	Tangential	Wall	Cyclone	Stoker
Gas Only	0.20	0.20	-	-
Gas/Oil	0.25	0.25	0.43	-
Coal Wet	1.00	1.00	0.60	-
Coal Dry	0.42	0.45	-	0.30

Table 5-2: New NOx RACT Limits Effective Starting from July 1, 2014

Fuel Type	Boiler Type (Pounds/mmBTU or #/mmBTU)			
	Tangential	Wall	Cyclone	Fluidized Bed
Gas Only	0.08	0.08	-	-
Gas/Oil	0.15	0.15	0.20	-
Coal Wet	0.12	0.12	0.20	-
Coal Dry	0.12	0.12	-	0.08

Using publicly available information from USEPA and USEIA, estimated NOx emission rates can be determined across the operating spectrum for various combinations of fuels for specific units greater than 15 MW. Using this information, the NYISO has analyzed potential NOx emissions under the lower NOx RACT standards to determine if the system emission averaging plans can be achieved. The analysis has focused on the peak day July 19, 2013 in Zone J. It appears that compliance with the TC Ravenswood emission plan should be feasible without imposing the operating limits on the affected units.

The analysis of the NRG bubble shows that operation of the complete fleet of gas turbines could be sustained in a manner consistent with the actual operating profile on the peak day. Similarly, supplemental data provided by USPowerGen demonstrates that the fleet of gas turbines could operate in a manner similar to what it did on the peak day in 2013. Given that this analysis is based upon historic performance which occurred when the emission limits were higher, it is possible that the boilers could achieve lower emission rates and therefore the gas turbines could operate for more extended periods.

Conversely, invoking the Loss of Gas Minimum Oil Burn (LOG-MOB) reliability rule requires the boilers under certain conditions to burn residual fuel oil (RFO) which increases NOx emissions and reduces the ability of the boilers to produce necessary offsets. Incremental operation of the boilers on gas during off peak hours could mitigate the impact of increased NOx emissions from LOG-MOB on the reduced hours of operation of the gas turbine.

5.1.2. Best Available Retrofit Technology (BART)

The class of steam electric units constructed between 1963 and 1977 are subject to continuing emission reductions required by the Clean Air Act. In New York, there are 15 units in service with 7,531 MW of summer capacity that are affected. Table 5-3 identifies the new emission limitations in place for these units[6].

[6] The table is not intended to include all emission limitations.

Table 5-3: New BART Emission Limits

Applicable Plants	Unit(s)	DMNC (1) (MW)	SO_2	NOx	Particulate Matter
Arthur Kill	ST 3	500	-	0.15 #/mmBTU; 24 Hours.	-
Bowline	1, 2	758	0.37% S RFO	0.15 #/mmBTU for gas, and 0.25 #/mmBTU for oil; 24 Hours	-
Barrett	ST 02	196	0.37% S RFO	0.1/0.2 #/mmBTU Gas/ Oil; 24 Hours	0.1 #/mmBTU
Northport	1,2,3,4	1,583	0.7% S RFO	0.1/0.2 #/mmBTU Gas/ Oil; 24 Hours	-
Oswego	5,6	1,574	0.75% S RFO	383/665 tons per year	-
Ravenswood	ST 01, ST 02 and ST 03	1,693	0.30% S RFO	0.15 #/mmBTU 30 Day	-
Roseton	1, 2	1,227	0.55#/mmBTU	-	-
Danskammer	4	237(2)	0.09#/mmBTU; 24 Hours	0.12#/mmBTU; 24 Hours	0.06 #/mmBTU; 1 Hour
2014 In-Service		7,531			

Notes:

1. Summer capability from 2014 Gold Book
2. Not included in 2014 In-Service total

The new BART limits identified in Table 5-3 are not expected to affect availability of these units during times of peak demand.

5.1.3. Mercury and Air Toxics Standards (MATS)

The USEPA Mercury and Air Toxics Standards (MATS) will limit emissions of mercury and air toxics through the use of Maximum Achievable Control Technology (MACT) for Hazardous Air Pollutants (HAP) from coal and oil fueled steam generators with a nameplate capacity of 25 MW or more. MATS will affect 23 units in the NYCA that represent 10,300 MW of nameplate capacity. Compliance requirements begin in March 2015 with an extension through March 2017 for Reliability Critical Units (RCU).

The majority of the New York coal fleet has installed emission control equipment that may place compliance within reach. One coal fired unit in New York is considering seeking an extension of the compliance deadline to March 2017.

The heavy oil-fired units will need to either make significant investments in emission control technology or switch to a cleaner mix of fuels in order to comply with the proposed standards. Given the current outlook for the continued attractiveness of natural gas compared to heavy oil, it is anticipated that compliance can be achieved by dual fuel units through the use of natural gas to maintain fuel ratios that are specified in the regulation[7].

5.1.4. Mercury Reduction Program for Coal-Fired Electric Utility Steam Generating Units (MRP)

New York State also has a mercury emission limit program for coal fired units. Phase II of the program begins January 1, 2015. The allowable emission limit is half of the MATS standard. The impact of the MRP requirements is shown below Section 5.2.

5.1.5. Cross State Air Pollution Rule (CSAPR)

The CSAPR establishes a new allowance system for units with at least 25 MW nameplate capacity or more. Affected generators will need one allowance for each ton emitted in a year. In New York, CSAPR will affect 154 units that represent 25,900 MW of nameplate capacity. The USEPA estimated New York's annual allowance costs for 2012 at $65 million. There are multiple scenarios which show that New York's generation fleet can operate in compliance with the program in the first phase. Compliance actions for the second phase may include emission control retrofits, fuel switching, and new clean efficient generation. The US Supreme Court upheld the CSAPR regulation and remanded the case to the District of Columbia Circuit Court of Appeals to resolve the remaining litigation and work with the USEPA to develop a revised implementation schedule. Further, since the rule was finalized in 2012, two National Ambient Air Quality Standards, for SO2 and Ozone, have been promulgated. The USEPA may recognize these new standards, unit retirements, and/ or changes in load and fuel forecasts in updated modeling that may be necessary for implementation of the CSAPR. EPA has filed with the D.C. Circuit Court of Appeals requesting authority to implement the rule in January 2015.

While the CSAPR is updated and implementation plans are finalized, the Clean Air Interstate Rule (CAIR) remains in effect. CAIR also employs an allowance based system to reduce emissions of SO2 and NOx over time. The rule is designed to begin Phase II on January 1, 2015 with an approximate 50% reduction in emission allowances entering the marketplace. The CAIR marketplace is currently oversupplied with SO2 and NOx emissions allowances, which has resulted in prices that are relatively low. It is expected that the continued operation of CAIR will not impact either the amount of capacity available or the relative dispatch order.

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[7] The MATS regulation provides for an exemption for units that use oil for less than ten percent of heat input annually over a three year period, and less than 15 percent in any given year. The regulation provides for an exemption from emission limits for units that limit oil use to less than the amount equivalent to an eight percent capacity factor over a two year period.

5.1.6. Regional Greenhouse Gas Initiative (RGGI) and USEPA Proposed Carbon Rules

The Regional Greenhouse Gas Initiative established a cap over CO2 emissions from most fossil fueled units of 25 MW or more in 2009. Phase II of the RGGI program became effective January 1, 2014 and reduces the cap by 45% to 91,000,000 tons for 2014. Phase II then applies annual emission cap reductions of 2.5% until 2020. One RGGI Allowance is required for each ton of CO2 emitted during a three year compliance period. A key provision to keep the allowance and electricity markets functioning is the provision of a Cost Containment Reserve (CCR). If demand exceeds supply at predetermined trigger prices an additional 10,000,000 (5,000,000 in 2014) allowances will be added to the market. Trigger prices are set to rise to $10/ton in 2017 and escalate at 2.5% annually thereafter. RGGI Inc. modeling analyses show that the trigger prices will be reached on several occasions throughout the period. Coal units may be further handicapped by the cost of carbon emission allowances, which could add up to $5/MWh in cost compared to older combined cycle units and up to $10/MWh for non-emitting machines.

The USEPA is in the process of promulgating New Source Performance Standards designed to limit CO2 emissions from new fossil fueled steam generators and combined cycle units. While the proposed rule would present significant technological challenges for coal fired units; for gas fired units, the rules are generally less stringent than NYSDEC's existing Part 251 emission regulations. USEPA's rule does not apply to simple cycle turbines that limit their sales to the grid to less than one-third of their potential electrical output.

On June 2, 2014, the USEPA proposed a rule to limit CO2 emissions from existing power plants by 30% from 2005 levels[8]. The rule is designed to lower emission rates from 2012 as measured in terms of # CO2/MWh, however, it does allow states to develop mass based systems such as RGGI. The proposal calls for an initial reduction by 2020 while achievement of the final reductions will be required by 2030. State implementation plans can make use of: (i) coal fired plant efficiency improvements; (ii) shifts in dispatch patterns to increase production from natural gas fired combined cycle plants; (iii) increased construction and operation of low and non-emitting generators; and (iv) aggressive deployment of energy efficiency measures. The proposal calls for the continued operation of existing and completion of new nuclear plants.

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[8] The proposed rule is extensive in length, broad in scope, and presents a complex approach to establishing base lines and future emission reduction requirements. The comment period closes in mid-October. The rule will be finalized in June of 2015. State Implementation Plans will be developed with public participation over the following year, or three year period if regional plans are proposed. The NYISO analysis will be a continuing effort over the next several years. At important points in the process, reports will be provided to stakeholders identifying the issues of importance to the NYISO.

5.1.7. RICE: NSPS and NESHAP

In January 2013, the USEPA finalized two new rules that apply to engine powered generators typically used as emergency generators. Some of the affected generators also participate in the NYISO's Special Case Resource (SCR) or Emergency Day-ahead Response (EDRP) Programs. EPA finalized National Emission Standards for Hazardous Air Pollutants (NESHAP), and New Source Performance Standards (NSPS), for Reciprocating Internal Combustion Engines (RICE). The new rules are designed to allow older emergency generators that do not meet the EPA's rules to comply by limiting operations in non-emergency events to less than 15 hours per year. These resources can participate in utility and NYISO emergency demand response programs; however the engine operation is limited to a maximum of 100 hours per year for testing and utility or the NYISO emergency demand response operations for which a Level 2 Energy Emergency Alert is called by the grid operator.

The New York DEC is also developing rules to control emissions of NOx and particulate matter (PM10 and 2.5) from engine driven generators that participate in the EDRP. The proposed rules will apply to all such generators above 150 kW in New York City and above 300 kW in the remainder of the State not already covered by a Title V Permit containing stricter NOx and PM limits. Depending on their specific types, it appears that engines purchased since 2005 and 2006 should be able to operate within the proposed limits. Older engines can be retrofitted with emission control packages, replaced with newer engines, or cease participation in the demand response programs. The proposed rule is generally comparable to rules already in place in a number of other states within the Ozone Transport Region. NYSDEC's estimated compliance schedule is still developing, with a currently contemplated compliance schedule of mid -2016.

5.1.8. Best Technology Available (BTA)

The USEPA has proposed a new Clear Water Act Section 316 b rule providing standards for the design and operation of power plant cooling systems. This rule will be implemented by NYSDEC, which has finalized a policy for the implementation of the Best Technology Available (BTA) for plant cooling water intake structures. This policy is activated upon renewal of a plant's water withdrawal and discharge permit. Based upon a review of current information available from NYSDEC, the NYISO has estimated that between 4,200-7,200 MW of nameplate capacity could be required to undertake major system retrofits, including closed cycle cooling systems. One high profile application of this policy is the Indian Point nuclear power plant. Table 5-4 shows the current status of plants under consideration for BTA determinations.

Table 5-4: NYSDEC BTA Determinations (as of March 2014)

Plant	Status
Arthur Kill	BTA Decision made, monitoring
Astoria	BTA Decision made, installing equipment
Barrett	Repowering Study underway, otherwise closed cycle
Bowline	BTA Decision made, capacity factor limited to 15% over 5 years
Brooklyn Navy Yard	BTA Decision made, installing upgrades
Cayuga	BTA Decision made, install screens, UPP accepted, Sierra Club challenged
Dunkirk	BTA Decision made, monitoring
East River	BTA installed, monitoring
Fitzpatrick	NYSDEC ready to issue BTA determination for offshore intake and screens
Fort Drum	BTA installed, monitoring
Ginna	BTA Decision 2015 or later
Huntley	BTA Decision capacity factor limited and variable speed pumps, NRG and Sierra Club have requested hearings
Indian Point	Hearings, BTA Decision 2016 at the earliest
Nine Mile Pt 1	Possible BTA determination this year
Northport	Possible BTA determination next year
Oswego	Lower priority for NYSDEC, possibly capacity factor limited
Port Jefferson	BTA installed, monitoring
Ravenswood	BTA installed, monitoring
Roseton	In hearings
Somerset	Possible BTA determination this year

The owners of Bowline have accepted a limit on the duration of operation of the plant as their compliance method. NYSDEC's BTA Policy allows units to operate with 15% capacity factor averaged over a five year period provided that impingement goals are met and the plant is operated in a manner that minimizes entrainment. Close inspection of the 2014 RNA MARS simulations shows that Bowline plant was committed at less than the 15% capacity factor limitation; thus imposing the BTA capacity factor limit does not degrade the NYCA LOLE.

More recently, a draft State Pollution Discharge Elimination System permit was issued for public comment for Huntley Station. The draft contained the 15% capacity factor limitation over the next five year period following finalization of the permit. If the proposed operating limitation were to become effective, the output of the plant would need to be significantly reduced over the five year period following finalization of the Huntley SPDES permit, as compared to recent production. The loss of output from Huntley could reduce transfer limits in the area, thereby altering production at Niagara and limiting imports from Ontario. To reflect the impact, the MARS topology for 2014 RNA implemented dynamic limit tables for Dysinger East and Zone A Group interfaces; details are described in Appendix D.

5.2. Summary of Environmental Regulation Impacts

Table 5-4 summarizes the impact of the new environmental regulations. Approximately 33,800 MW of nameplate capacity may be affected to some extent by these regulations. Compliance plans are in place for NOx RACT, BART, and RGGI. Reviewing publicly available information from USEPA and USEIA, most generators affected by MATS and MRP have demonstrated operations with emission levels consistent with the new regulations. BTA determinations are the result of extensive studies and negotiations that in most cases have not resulted in decisions requiring conversion to closed cycle cooling systems. These determinations are made on a plant specific schedule. The Indian Point Nuclear Plant BTA determination is the subject of an extensive hearing and Administrative Law Judge determination process that will continue through 2015.

Table 5-5: Impact of New Environmental Regulations

Program	Status	Compliance Deadline	Approximate Nameplate Capacity
NOx RACT	In effect	July 2014	27,100 MW (221 units)
BART	In effect	January 2014	8,400 MW (15 units)
MATS	In effect	April 2015/2016/2017	10,300 MW (23 units)
MRP	In effect	January 2015	1,500 MW (6 units)
CSAPR	Supreme Court validated USEPA rule	TBD	26,300 MW (160 units)
RGGI	In effect	In effect	25,800 MW (154 units)
BTA	In effect	Upon permit Renewal	16,400 MW (34 units)

Using publicly available information from USEPA and USEIA, the NYISO further identified the units that may experience significant operational impacts from the environmental regulations. The summary is provided below and in Table 5-6:

- *NOx RACT program*: It appears that compliance with each of the three NOx bubble limitation is achievable.
- *BART limits*: The Oswego Units #5 and #6 are estimated to be able to start and operate at maximum output for many more days than they have been committed historically. Accordingly, imposing these estimated BART operating limits does not change NYCA LOLE in 2014 RNA.
- *MATS/MRP Program*: Given the current outlook for the continued attractiveness of natural gas compared to heavy oil, it is anticipated that compliance can be achieved by dual fuel units through the use of natural gas to maintain fuel ratios that are specified in the regulation.
- *RGGI*: The impact of RGGI may increase the operating cost of all coal units. Should all coal units retire, loss of nearly 1,500 MW in upstate would cause LOLE to exceed 0.1/day in year 2017 or before, and cause reliability violations.

Table 5-6: Summary of Potentially Significant Operational Impacts due to New Environmental Regulations

Program	Status	Significant Operational Impacts	Future Operations Potentially Impacted	Capacity (MW)
NOx RACT	July 2014	Three NYC NOx bubbles	Arthur Kill, Astoria Gas Turbines, Astoria, Narrows, Gowanus, Ravenswood	5,300
BART	In effect	Emission caps	Oswego 5 & 6: limited number of days for operations at peak	1,600
MATS/MRP	April 2015/6/7	Oil use limits	Astoria, Ravenswood, Northport, Barrett, Port Jefferson, Bowline, Roseton, Oswego	8,800
CSAPR	Uncertain	Cost increases	Uncertain	
RGGI	In effect	Cost increases up to $10/MWH	All Coal units	1,450
BTA	Permit Renewal	Potential retirements or capacity factor limits	Indian Point, Bowline, and Huntley	3,200

6. Fuel Adequacy

6.1. Gas Infrastructure Adequacy Assessment

As the plentiful low cost gas produced in the Marcellus Shale makes its way into New York, the amount of electrical demand supplied and energy produced by this gas have steadily increased. The benefits of this shift in the relative costs of fossil fuels include reduced emissions, improved generation efficiency, and lower electricity prices. These benefits, however, are accompanied by a reduction in overall fuel diversity in NYCA. This reduction in fuel diversity has led to the Eastern Interconnection Planning Collaborative (EIPC) gas and electric infrastructure study and FERC proceedings addressing gas and electric system communications, and market coordination, all of which are intended to improve the knowledge base for electric and gas system planners, operators, and policy makers.

The NYISO has recently completed a study that examined the ability of the regional natural gas infrastructure to meet the reliability needs of New York's electric system. Specifically the study provided a detailed review of New York gas markets and infrastructure, assessed historic pipeline congestion patterns, provided an infrastructure and supply adequacy forecast and examined postulated contingency events. Importantly, the study concluded there will be no unserved gas demand for generation on the interstate gas pipeline systems throughout the next five years, even with the retirement of Indian Point and related replacement of that generation with 2,000 MW of new capacity in the Lower Hudson Valley.

The study did not examine the impact of intra-state pipeline deliverability constraints on the LDC systems. The study did document increasing congestion on key pipelines in New York resulting from increased gas demand in New England and to a lesser degree by in- state demand increases for generation. Gas fired generators located on constrained pipeline segments may continue to experience gas supply curtailments over the study horizon. Gas pipeline expansions under construction and planned will materially increase delivery capability and result in reduced delivery basis and future interruptions. The market for gas supply forward contracts has already made significant adjustment to recognize the future completion of these projects. The price difference between Henry Hub and the NYC represented by the Transco NY 6 delivery point has disappeared except for a small number of incidences in the winter months. Moreover, New York is fortunate to have dual fuel capability installed at the majority of its gas fired generators.

The NYISO conducted surveys in October 2012 and October 2013 to verify dual fuel capability. Based on the October 2013 survey results, it was determined that of 18,011 MW (Summer DMNC) dual fuel generators reported in the 2013 Gold Book, 16,983 MW have permits that allow them to operate on oil. In addition, there were 2,505 MW (Summer DMNC) oil-only generators reported in the 2013 Gold Book; based on the October 2013 Survey results, this has increased to 2,579 MW (Summer DMNC). Thus, the summer capability of oil and dual fuel units with oil permits totals 19,562 MW. These oil and dual fuel facilities represent a strong fleet of resources that can respond to delivery disruptions on the gas pipeline system during both summer and winter seasons.

6.2. Loss of Gas Supply Assessment

Loss of Gas Supply Assessment was conducted as part of the NYISO 2013 Area Transmission Review (ATR). The findings of the assessment are summarized below.

Natural gas-fired generation in NYCA is supplied by various networks of major gas pipelines, as described in Appendix O of the 2013 ATR. NYCA generation capacity has a balance of fuel mix which provides operational flexibility and reliability. Several generation plants have dual fuel capability. Based on the NYISO 2013 Gold Book, 8% of the generating capacity is fueled by natural gas only, 47% by oil and natural gas, and the remainder is fueled by oil, coal, nuclear, hydro, wind, and other.

The loss of gas supply assessment was performed using the winter 2018 50/50 forecast of the coincident peak load. The power flow base case was developed by assuming all gas only units and dual fuel units that do not have a current license to operate with the alternative fuel are not available due to a gas supply shortage. The total reduction in generating capacity was 4,251 MW; however, only 2,777 MW had to be redispatched due to the modeling assumptions in the base case. N-1 and N-1-1 thermal and voltage analysis was performed using the TARA program monitoring bulk system voltages and all 115 kV and above elements for post-contingency LTE thermal ratings.

No thermal or voltage violations are observed in addition to those already identified for the summer peak conditions for this extreme system condition. The only stability issue noted for this gas shortage scenario was an undamped response to a single-line to ground stuck breaker fault at Marcy on the Marcy – Volney 345kV line. Possible mitigation would be to balance the VAr flow from each plant at the Oswego complex or redispatching the Oswego complex.

The capacity of 2014-2015 winter is summarized in Table 6-1 below. In the event that NYCA loses gas-only units, the remaining capacity is sufficient to supply the load. However, in the extreme case that NYCA loses gas-only units, and simultaneously the oil inventory of all dual-fuel units has been depleted, a total capacity of 16,879 MW would be unavailable. As the consequence of such an extreme event, the remaining generation would not be sufficient to supply NYCA load.

Table 6-1: Loss of Gas Assessment for 2014-2015 Winter

2015 Winter Capacity (MW)	
Peak Load	24,737
NYCA winter capacity	40,220
If gas-only units lose gas supply	
Gas-only capacity	-3,568
Total remaining capacity	36,652
If gas-only and dual-fuel units lose gas supply and deplete oil	
Gas only capacity	-3,568
Dual-fuel capacity	-16,879
Total remaining capacity	19,773

6.3. Summary of Other Ongoing NYISO efforts

The NYISO has been working with stakeholders and other industry groups to identify and address fuel adequacy concerns. Most notably, the Electric Gas Coordination Working Group (EGCWG) and EIPC are actively studying related issues. The efforts are summarized in this section.

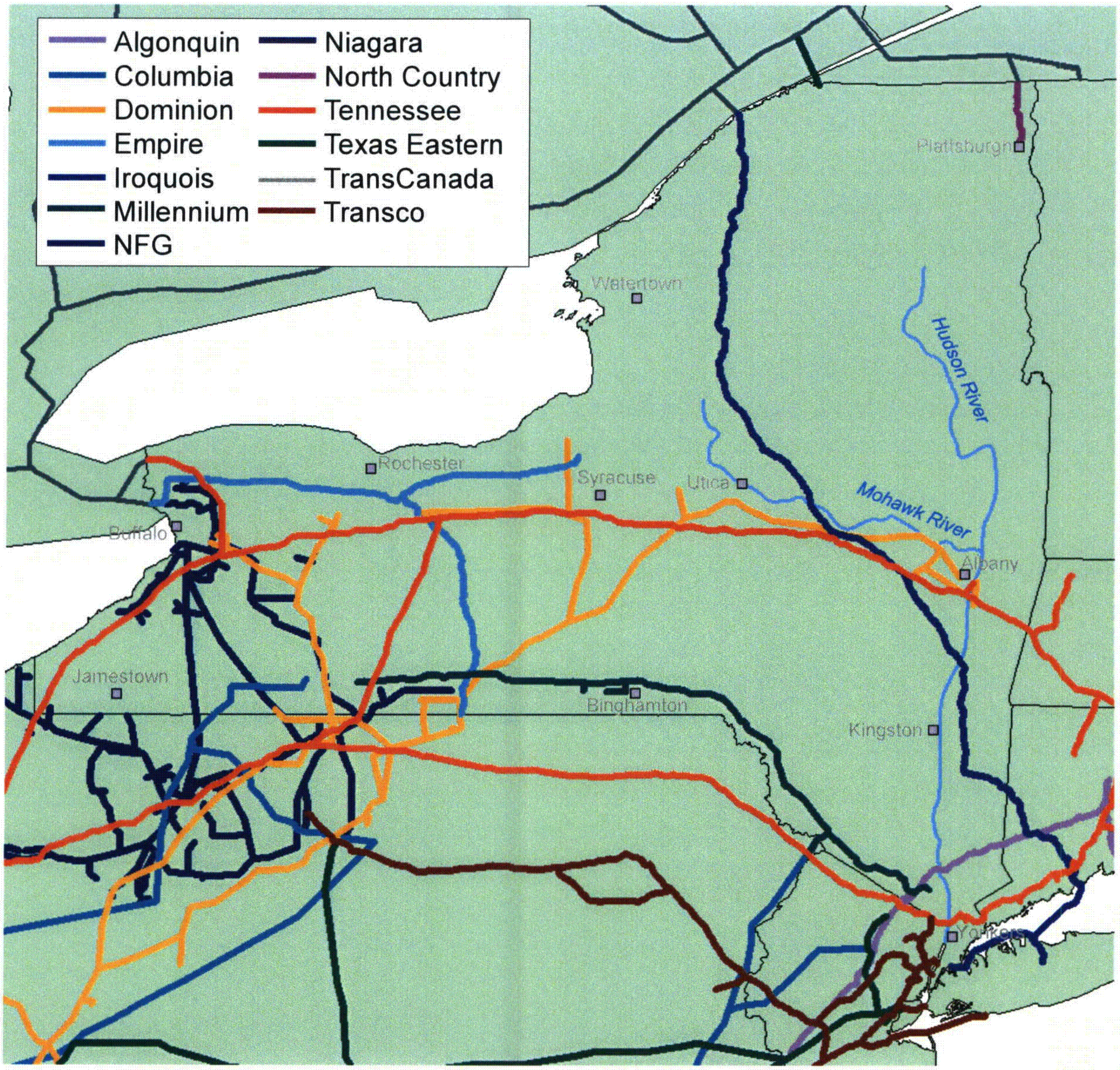
At EGCWG, the efforts are focusing on gas-electric coordination issues within NYCA. The NYISO retained Levitan & Associates (LAI) to prepare the following reports:

- "Fuel Assurance Operating and Capital Costs for Generation in NYCA" (Task 1)
- The "NYCA Pipeline Congestion and Infrastructure Adequacy Assessment" (Task 2)

The final study reports have been completed and are posted on the NYISO website[9]. The consolidated network of interstate pipelines serving New York is shown in Figure 6-1.

[9] Task 1 final report: http://www.nyiso.com/public/committees/documents.jsp?com=bic_egcwg&directory=2013-06-17
Task 2 final report:
http://www.nyiso.com/public/webdocs/markets_operations/committees/bic_egcwg/meeting_materials/2013-10-23/Levitan%20Pipeline%20Congestion%20and%20Adequacy%20Report%20Sep13%20-%20Final%20CEII%20Redacted.pdf

Figure 6-1: Natural Gas Pipeline Network in NYCA



At EIPC, six Participating Planning Authorities (PPAs) are actively involved in the Gas-Electric System Interface Study, which includes ISO-NE, NYISO, PJM, IESO, TVA, and MISO (includes the Entergy system). The efforts are focusing on gas-electric coordination issues in the region across the six PAs. The study has four targets:

1. Develop a baseline assessment that includes description of the natural gas-electric system interface(s) and how they impact each other.
2. Evaluate the capability of the natural gas system(s) to supply the individual and aggregate fuel requirement from the electric power sector over a five and ten year study horizon.
3. Identify contingencies on the natural gas system that could adversely affect electric system reliability and vice versa.
4. Review operational and planning issues and any changes in planning analysis and operations that may be impacted by the availability or non-availability of dual fuel capability at generating units.

Target 1 has been completed, and the report is posted on EIPC website[10]. Target 2 is currently underway, while Targets 3 and 4 are in the planning stage.

[10] http://www.eipconline.com/Gas-Electric_Documents.html

7. Observations and Recommendations

The 2014 Reliability Needs Assessment (RNA) assesses resource adequacy and both transmission security and adequacy of the New York Control Area (NYCA) bulk power transmission system from year 2015 through 2024, the study period of this RNA. The 2014 RNA identifies transmission security needs in portions of the bulk power transmission system, and a NYCA LOLE violation due to inadequate resource capacity located in Southeast New York (SENY).

The NYISO finds transmission security violations beginning in 2015, some of which are similar to those found in the 2012 RNA. The NYISO also identifies resource adequacy violations, which begin in 2019 and increase through 2024, if they are not resolved.

For transmission security, there are four primary regions with reliability needs: Rochester, Western & Central New York, Capital Region, and Lower Hudson Valley & New York City. These reliability needs are generally driven by recent and proposed generator retirements or mothballing combined with load growth. The New York transmission owners have developed plans through their respective local transmission planning processes to construct transmission projects to meet not only the needs identified in the previous RNA, but also any additional needs occurring since then and prior to this RNA. These transmission projects, subject to inclusion rules, have been modeled in the 2014 RNA base case. Reliability needs identified in this report exist despite the inclusion of the transmission projects in the base case. The transmission security needs in the Buffalo and Binghamton areas are influenced by whether the fuel conversion project can be completed for the Dunkirk Plant for it to return to service by 2016. As a result, this project was addressed as a sensitivity and the impact of the results are noted with the base case reliability needs.

While resource adequacy violations continue to be identified in SENY, the 2014 RNA is projecting the need year to be 2019, one year before the need year identified in the 2012 RNA. The most significant difference between the 2012 RNA and the 2014 RNA is the decrease of the NYCA capacity margin (the total capacity less the peak load forecast).

The NYISO expects existing and recent market rule changes to entice market participants to take actions that will help meet the resource adequacy needs in SENY, as identified by the 2012 RNA and the 2014 RNA. The resources needed downstream of the upstate New York to SENY interface is approximately 1,200 MW in 2024 (100 MW in 2019), which could be transmission or capacity resources. The new Zones G-J Locality will provide market signals for resources to provide service in this area. Capacity owners and developers are taking steps to return mothballed units to service, restore units to their full capability, or build new in the Zones G-J Locality. If some or all of these units return to service or are developed, the reliability need year would be postponed beyond 2019. In addition, New York State government is promoting transmission development to relieve the transmission constraints between upstate New York and SENY, which could also defer the need for additional resources. The NYISO anticipates that such potential solutions will be submitted for evaluation during the solutions phase of the Reliability Planning Process (RPP) and included in the upcoming 2014 Comprehensive Reliability Plan (CRP) if appropriate.

As a backstop to market-based solutions, the NYISO employs a process to define responsibility should the market fail to provide an adequate solution to an identified reliability need. Since there are transmission security violations in Zones A, B, C, E, and F within the study period, the transmission owners (TOs) in those zones (i.e., National Grid, RGE, and NYSEG) are responsible and will be tasked to develop detailed regulated backstop solutions for evaluation in the 2014 CRP.

Given the limited time between the identification of certain transmission security needs in this RNA report and their occurrence in 2015, the use of demand response and operating procedures, including those for emergency conditions, may be necessary to maintain reliability during peak load periods until permanent solutions can be put in place. Accordingly, the NYISO expects the TOs to present updates to their Local Transmission Owner Plans for these zones, including their proposed operating procedures pending completion of their permanent solutions, for review and acceptance by the NYISO and in the 2014 CRP.

The NYISO identified reliability needs for resource adequacy in SENY starting in the year 2019; therefore, the TOs in SENY (i.e., Orange & Rockland, Central Hudson, New York State Electric and Gas, Con Edison, and LIPA) are responsible to develop the regulated backstop solution(s). The study also identified a transmission security violation in 2022 on the Leeds-Pleasant Valley 345 kV circuit, and this circuit is the main constraint of the Upstate New York to Southeast New York (UPNY-SENY) interface identified in the resource adequacy analysis. Therefore, the violation could be resolved by solution(s) that respond to the resource adequacy deficiencies identified for 2019 – 2024.

If the resource adequacy solution is non-transmission, these reliability needs can only be most efficiently satisfied through the addition of compensatory megawatts in SENY because such resources need to be located below the UPNY-SENY interface constraint to be effective. Additions in Zones A through F could partially resolve these reliability needs. Potential solutions could include a combination of additional transfer capability by adding transmission facilities into SENY from outside those zones and/or resource additions at least some of which would be best located in SENY.

The RNA is the first step of the NYISO reliability planning process. As a product of this step, the NYISO documents the reliability needs in the RNA report, which is presented to the NYISO Board of Directors for approval. The NYISO Board approval initiates the second step, which involves the NYISO requesting proposed solutions to mitigate the identified needs to maintain acceptable levels of system reliability throughout the study period.

8. Historic Congestion

Appendix A of Attachment Y of the NYISO OATT states: "As part of its CSPP, the ISO will prepare summaries and detailed analysis of historic and projected congestion across the NYS Transmission System. This will include analysis to identify the significant causes of historic congestion in an effort to help Market Participants and other interested parties distinguish persistent and addressable congestion from congestion that results from onetime events or transient adjustments in operating procedures that may or may not recur. This information will assist Market Participants and other stakeholders to make appropriately informed decisions." The detailed analysis of historic congestion can be found on the NYISO Web site.[11]

11 http://www.nyiso.com/public/markets_operations/services/planning/documents/index.jsp

Appendices A – D

Appendix A – 2014 Reliability Needs Assessment Glossary

Term	Definition
10-year Study Period	10-year period starting with the year after the study is dated and projecting forward 10 years. For example, the 2014 RNA covers the 10-year Study Period of 2015 through 2024.
Adequacy	Encompassing both generation and transmission, adequacy refers to the ability of the bulk power system to supply the aggregate requirements of consumers at all times, accounting for scheduled and unscheduled outages of system components.
Alternative Regulated Solutions	Regulated solutions submitted by a TO or other developer in response to a solicitation by the ARS, if the NYISO determines that there is a Reliability Need.
Annual Transmission Reliability Assessment (ATRA)	An assessment, conducted by the NYISO staff in cooperation with Market Participants, to determine the System Upgrade Facilities required for each generation and merchant transmission project included in the Applicable Reliability Standards, to interconnect to the New York State Transmission System in compliance with Applicable Reliability Standards and the NYISO Minimum Interconnection Standard.
Area Transmission Review (ATR)	The NYISO, in its role as Planning Coordinator, is responsible for providing an annual report to the NPCC Compliance Committee in regard to its Area Transmission Review in accordance with the NPCC Reliability Compliance and Enforcement Program and in conformance with the NPCC Design and Operation of the Bulk Power System (Directory #1).
Best Available Retrofit Technology (BART)	NYS DEC regulation, required for compliance with the federal Clean Air Act, applying to fossil fueled electric generating units built between August 7, 1962 and August 7, 1977. Emissions control of SO_2, NOx and PM may be necessary for compliance. Compliance deadline is January 2014.
Best Technology Available (BTA)	NYS DEC policy establishing performance goals for new and existing electricity generating plants for Cooling Water Intake Structures. The policy would apply to plants with design intake capacity greater than 20 million gallons/day and prescribes reductions in fish mortality. The performance goals call for the use of wet, closed-cycle cooling systems at existing generating plants.
New York State Bulk Power Transmission Facility (BPTF)	The facilities identified as the New York State Bulk Power Transmission Facilities in the annual Area Transmission Review submitted to NPCC by the ISO pursuant to NPCC requirements.
Capability Period	The Summer Capability Period lasts six months, from May 1 through

Term	Definition
	October 31. The Winter Capability Period runs from November 1 through April 30 of the following year.
Capacity	The capability to generate or transmit electrical power, or the ability to reduce demand at the direction of the NYISO.
Capacity Resource Integration Service (CRIS)	CRIS is the service provided by NYISO to interconnect the Developer's Large Generating Facility or Merchant Transmission Facility to the New York State Transmission System in accordance with the NYISO Deliverability Interconnection Standard, to enable the New York State Transmission System to deliver electric capacity from the Large Generating Facility or Merchant Transmission Facility, pursuant to the terms of the NYISO OATT.
Class Year	The group of generation and merchant transmission projects included in any particular Annual Transmission Reliability Assessment (ATRA), in accordance with the criteria specified for including such projects in the assessment.
Clean Air Interstate Rule (CAIR)	USEPA rule to reduce interstate transport of fine particulate matter (PM) and ozone. CAIR provides a federal framework to limit the emission of SO_2 and NOx.
Comprehensive Reliability Plan (CRP)	A biennial study undertaken by the NYISO that evaluates projects offered to meet New York's future electric power needs, as identified in the Reliability Needs Assessment (RNA). The CRP may trigger electric utilities to pursue regulated solutions or other developers to pursue alternative regulated solutions to meet Reliability Needs, if market-based solutions will not be available by the need date. It is the second step in the Reliability Planning Process (RPP).
Comprehensive System Planning Process (CSPP)	A transmission system planning process that is comprised of three components: 1) Local transmission owner planning; 2) Compilation of local plans into the Reliability Planning Process (RPP), which includes developing a Comprehensive Reliability Plan (CRP); 3) Channeling the CRP data into the Congestion Assessment and Resource Integration Study (CARIS)
Congestion Assessment and Resource Integration Study (CARIS)	The third component of the Comprehensive System Planning Process (CSPP). The CARIS is based on the Comprehensive Reliability Plan (CRP).
Congestion	Congestion on the transmission system results from physical limits on how much power transmission equipment can carry without exceeding thermal, voltage and/or stability limits determined to maintain system reliability.

Term	Definition
Contingencies	Contingencies are individual electrical system events (including disturbances and equipment failures) that are likely to happen.
Cross-State Air Pollution Rule (CSARP)	This USEPA rule requires the reduction of power plant emissions that contribute to exceedances of ozone and/or fine particle standards in other states.
Dependable Maximum Net Capability (DMNC)	The sustained maximum net output of a generator, as demonstrated by the performance of a test or through actual operation, averaged over a continuous time period as defined in the ISO Procedures. The DMNC test determines the amount of Installed Capacity used to calculate the Unforced Capacity that the Resource is permitted to supply to the NYCA.
Electric System Planning Work Group (ESPWG)	A NYISO governance working group for Market Participants designated to fulfill the planning functions assigned to it. The ESPWG is a working group that provides a forum for stakeholders and Market Participants to provide input into the NYISO's Comprehensive System Planning Process (CSPP), the NYISO's response to FERC reliability-related Orders and other directives, other system planning activities, policies regarding cost allocation and recovery for regulated reliability and/or economic projects, and related matters.
Energy Efficiency Portfolio Standard (EEPS)	A statewide program ordered by the NYDPS in response to the Governor's call to reduce New Yorkers' electricity usage by 15% of 2007 forecast levels by the year 2015, with comparable results in natural gas conservation.
Federal Energy Regulatory Commission (FERC)	The federal energy regulatory agency within the U.S. Department of Energy that approves the NYISO's tariffs and regulates its operation of the bulk electricity grid, wholesale power markets, and planning and interconnection processes.
FERC 715	Annual report that is required by transmitting utilities operating grid facilities that are rated at or above 100 kilovolts. The report consists of transmission systems maps, a detailed description of transmission planning Reliability Criteria, detailed descriptions of transmission planning assessment practices, and detailed evaluation of anticipated system performance as measured against Reliability Criteria.
Forced Outage	An unanticipated loss of capacity due to the breakdown of a power plant or transmission line. It can also mean the intentional shutdown of a generating unit or transmission line for emergency reasons.
Gap Solution	A solution to a Reliability Need that is designed to be temporary and to strive to be compatible with permanent market-based proposals. A permanent regulated solution, if appropriate, may proceed in parallel with a Gap Solution. The NYISO may call for a Gap Solution to

Term	Definition
	an imminent threat to reliability of the Bulk Power Transmission Facilities if no market-based solutions, regulated backstop solutions, or alternative regulated solutions can meet the Reliability Needs in a timely manner.
Gold Book	Annual NYISO publication of its Load and Capacity Data Report.
Installed Capacity (ICAP)	A Generator or Load facility that complies with the requirements in the Reliability Rules and is capable of supplying and/or reducing the demand for Energy in the NYCA for the purpose of ensuring that sufficient Energy and Capacity are available to meet the Reliability Rules. The Installed Capacity requirement, established by the New York State Reliability Council (NYSRC), includes a margin of reserve in accordance with the Reliability Rules.
Installed Reserve Margin (IRM)	The amount of installed electric generation capacity above 100% of the forecasted peak electric demand that is required to meet NYSRC resource adequacy criteria. Most studies in recent years have indicated a need for a 15-20% reserve margin for adequate reliability in New York.
Interconnection Queue	A queue of transmission and generation projects that have submitted an Interconnection Request to the NYISO to be interconnected to the New York State Transmission System. All projects must undergo three studies – a Feasibility Study (unless parties agree not to perform it), a System Reliability Impact Study (SRIS) and a Facilities Study – before interconnecting to the grid.
Local Transmission Plan (LTP)	The Local Transmission Owner Plan, developed by each Transmission Owner, which describes its respective plans that may be under consideration or finalized for its own Transmission District.
Local Transmission Owner Planning Process (LTPP)	The first step in the Comprehensive System Planning Process (CSPP), under which transmission owners in New York's electricity markets provide their local transmission plans for consideration and comment by interested parties.
Loss of load expectation (LOLE)	LOLE establishes the amount of generation and demand-side resources needed - subject to the level of the availability of those resources, load uncertainty, available transmission system transfer capability and emergency operating procedures - to minimize the probability of an involuntary loss of firm electric load on the bulk electricity grid. The state's bulk electricity grid is designed to meet an LOLE that is not greater than one occurrence of an involuntary load disconnection in 10 years, expressed mathematically as 0.1 days per year.
Market-Based Solutions	Investor-proposed projects that are driven by market needs to meet future reliability requirements of the bulk electricity grid as outlined in the RNA. Those solutions can include generation, transmission and

Term	Definition
	demand response Programs.
Market Monitoring Unit	A consulting or other professional services firm, or other similar entity, retained by the NYISO Board pursuant to ISO Services Tariff Section 30.4.6.8.1, Attachment O - Market Monitoring Plan.
Market Participant	An entity, excluding the ISO, that produces, transmits, sells, and/or purchases for resale Capacity, Energy and Ancillary Services in the Wholesale Market. Market Participants include: Transmission Customers under the ISO OATT, Customers under the ISO Services Tariff, Power Exchanges, Transmission Owners, Primary Holders, LSEs, Suppliers and their designated agents. Market Participants also include entities buying or selling TCCs.
Mercury and Air Toxics Standards (MATS)	The rule applies to oil and coal fired generators and establishes limits for HAPs, acid gases, mercury (Hg), and particulate matter (PM). Compliance is required by March 2015, with extensions to 2017 for reliability critical units.
Mercury Reduction Program for Coal-Fired Electric Utility Steam Generating Units (MRP)	NYSDEC regulation of mercury emissions from coal-fired electric utility steam generating units with a nameplate capacity of more than 25 MW producing electricity for sale.
National Ambient Air Quality Standards (NAAQS)	Limits, set by the EPA, on pollutants considered harmful to public health and the environment.
New York Control Area (NYCA)	The area under the electrical control of the NYISO. It includes the entire state of New York, and is divided into 11 zones.
New York State Department of Environmental Conservation (NYSDEC)	The agency that implements New York State environmental conservation law, with some programs also governed by federal law.
New York Independent System Operator (NYISO)	Formed in 1997 and commencing operations in 1999, the NYISO is a not-for-profit organization that manages New York's bulk electricity grid – an 11,056-mile network of high voltage lines that carry electricity throughout the state. The NYISO also oversees the state's wholesale electricity markets. The organization is governed by an independent Board of Directors and a governance structure made up of committees with Market Participants and stakeholders as members.
New York State Department of Public Service	As defined in the New York Public Service Law, it serves as the staff for the New York State Public Service Commission.

Term	Definition
(NYDPS)	
New York State Energy Research and Development Authority (NYSERDA)	A corporation created under the New York State Public Authorities law and funded by the System Benefits Charge (SBC) and other sources. Among other responsibilities, NYSERDA is charged with conducting a multifaceted energy and environmental research and development program to meet New York State's diverse economic needs, and administering state System Benefits Charge, Renewable Portfolio Standard, and Energy Efficiency Portfolio Standard programs.
New York State Public Service Commission (NYPSC)	The New York State Public Service Commission is the decision making body of the New York State Department of Public Service. The PSC regulates the state's electric, gas, steam, telecommunications, and water utilities and oversees the cable industry. The Commission has the responsibility for setting rates and ensuring that safe and adequate service is provided by New York's utilities. In addition, the Commission exercises jurisdiction over the siting of major gas and electric transmission facilities
New York State Reliability Council (NYSRC)	A not-for-profit entity that develops, maintains, and, from time-to-time, updates the Reliability Rules which shall be complied with by the New York Independent System Operator ("NYISO") and all entities engaging in electric transmission, ancillary services, energy and power transactions on the New York State Power System.
North American Electric Reliability Corporation (NERC)	A not-for-profit organization that develops and enforces reliability standards; assesses reliability annually via 10-year and seasonal forecasts; monitors the bulk power system; and educates, trains, and certifies industry personnel. NERC is subject to oversight by the FERC and governmental authorities in Canada.
Northeast Power Coordinating Council (NPCC)	A not-for-profit corporation responsible for promoting and improving the reliability of the international, interconnected bulk power system in Northeastern North America.
Open Access Transmission Tariff (OATT)	Document of Rates, Terms and Conditions, regulated by the FERC, under which the NYISO provides transmission service. The OATT is a dynamic document to which revisions are made on a collaborative basis by the NYISO, New York's Electricity Market Stakeholders, and the FERC.
Order 890	Adopted by FERC in February 2007, Order 890 is a change to FERC's 1996 transmission open access regulations (established in Orders 888 and 889). Order 890 is intended to provide for more effective competition, transparency and planning in wholesale electricity markets and transmission grid operations, as well as to strengthen the Open Access Transmission Tariff (OATT) with regard to non-

Term	Definition
	discriminatory transmission service. Order 890 requires Transmission Providers – including the NYISO – to have a formal planning process that provides for a coordinated transmission planning process, including reliability and economic planning studies.
Order 1000	Order No. 1000 is a Final Rule that reforms the FERC electric transmission planning and cost allocation requirements for public utility transmission providers. The rule builds on the reforms of Order No. 890 and provides for transmission planning to meet transmission needs driven by Public Policy Requirements, interregional planning, opens transmission development for new transmission needs to non-incumbent developers, and provides for cost allocation and recovery of transmission upgrades.
Outage	The forced or scheduled removal of generating capacity or a transmission line from service.
Peak Demand	The maximum instantaneous power demand, measured in megawatts (MW), and also known as peak load, is usually measured and averaged over an hourly interval.
Reasonably Available Control Technology for Oxides of Nitrogen (NOx RACT)	Regulations promulgated by NYSDEC for the control of emissions of nitrogen oxides (NOx) from fossil fueled power plants. The regulations establish presumptive emission limits for each type of fossil fueled generator and fuel used as an electric generator in NY. The NOx RACT limits are part of the State Implementation Plan for achieving compliance with the National Ambient Air Quality Standard (NAAQS) for ozone.
Reactive Power Resources	Facilities such as generators, high voltage transmission lines, synchronous condensers, capacitor banks, and static VAr compensators that provide reactive power. Reactive power is the portion of electric power that establishes and sustains the electric and magnetic fields of alternating-current equipment. Reactive power is usually expressed as kilovolt-amperes reactive (kVAr) or megavolt-ampere reactive (MVAr).
Regional Greenhouse Gas Initiative (RGGI)	A cooperative effort by nine Northeast and Mid-Atlantic states (not including New Jersey or Pennsylvania) to limit greenhouse gas emissions using a market-based cap-and-trade approach.
Regulated Backstop Solutions	Proposals required of certain TOs to meet Reliability Needs as outlined in the RNA. Those solutions can include generation, transmission or demand response. Non-Transmission Owner developers may also submit regulated solutions.
Reliability Criteria	The electric power system planning and operating policies, standards, criteria, guidelines, procedures, and rules promulgated by the North American Electric Reliability Corporation (NERC), Northeast Power

Term	Definition
	Coordinating Council (NPCC), and the New York State Reliability Council (NYSRC), as they may be amended from time to time.
Reliability Need	A condition identified by the NYISO in the RNA as a violation or potential violation of Reliability Criteria.
Reliability Needs Assessment (RNA)	A biennial study which evaluates the resource adequacy and transmission system adequacy and security of the New York bulk power system over a ten year Study Period. Through this evaluation, the NYISO identifies Reliability Needs in accordance with applicable Reliability Criteria.
Reliability Planning Process (RPP)	The biennial process that includes evaluation of resource adequacy and transmission system security of the state's bulk electricity grid over a 10-year period and evaluates solutions to meet those needs. The RPP consists of two studies: the RNA, which identifies potential problems, and the CRP, which evaluates specific solutions to those problems.
Renewable Portfolio Standard (RPS)	Proceeding commenced by order of the NYDPS in 2004 which established the goal to increase renewable energy used in New York State to 30% of total New York energy usage (equivalent to approximately 3,700 MW of capacity) by 2015.
Responsible Transmission Owner (Responsible TO)	The Transmission Owner(s) or TOs designated by the NYISO, pursuant to the NYISO RPP, to prepare a proposal for a regulated solution to a Reliability Need or to proceed with a regulated solution to a Reliability Need. The Responsible TO will normally be the Transmission Owner in whose Transmission District the NYISO identifies a Reliability Need.
Security	The ability of the power system to withstand the loss of one or more elements without involuntarily disconnecting firm load.
Special Case Resources (SCR)	A NYISO demand response program designed to reduce power usage by businesses and large power users qualified to participate in the NYISO's ICAP market. Companies that sign up as SCRs are paid in advance for agreeing to cut power upon NYISO request.
State Environmental Quality Review Act (SEQRA)	NYS law requiring the sponsoring or approving governmental body to identify and mitigate the significant environmental impacts of the activity/project it is proposing or permitting.
Study Period	The 10-year time period evaluated in the RNA.
System Reliability Impact Study (SRIS)	A study, conducted by the NYISO in accordance with Applicable Reliability Standards, to evaluate the impact of a proposed interconnection on the reliability of the New York State Transmission System.
System Benefits	An amount of money, charged to ratepayers on their electric bills,

Term	Definition
Charge (SBC)	which is administered and allocated by NYSERDA towards energy-efficiency programs, research and development initiatives, low-income energy programs, and environmental disclosure activities.
Transfer Capability	The measure of the ability of interconnected electrical systems to reliably move or transfer power from one area to another over all transmission facilities (or paths) between those areas under specified system conditions.
Transmission Constraints	Limitations on the ability of a transmission system to transfer electricity during normal or emergency system conditions.
Transmission Owner (TO)	A public utility or authority that owns transmission facilities and provides Transmission Service under the NYISO's tariffs
Transmission Planning Advisory Subcommittee (TPAS)	An identified group of Market Participants that advises the NYISO Operating Committee and provides support to the NYISO Staff in regard to transmission planning matters including transmission system reliability, expansion, and interconnection
Unforced Capacity Delivery Rights (UDR)	Unforced capacity delivery rights are rights that may be granted to controllable lines to deliver generating capacity from locations outside the NYCA to localities within NYCA.
Weather Normalized	Adjustments made to normalize the impact of weather when making energy and peak demand forecasts. Using historical weather data, energy analysts can account for the influence of extreme weather conditions and adjust actual energy use and peak demand to estimate what would have happened if the hottest day or the coldest day had been the typical, or "normal," weather conditions. "Normal" is usually calculated by taking the average of the previous 20 years of weather data.
Zone	One of the eleven regions in the NYCA connected to each other by identified transmission interfaces and designated as Load Zones A-K.

Appendix B - The Reliability Planning Process

This section presents an overview of the NYISO reliability planning process (RPP). A detailed discussion of the reliability planning process, including applicable Reliability Criteria, is contained in NYISO Manual entitled: "Reliability Planning Process Manual," which is posted on the NYISO's website.

The NYISO reliability planning process is an integral part of the NYISO's overall Comprehensive System Planning Process (CSPP). The CSPP planning process is comprised of the Local Transmission Planning Process (LTPP), the RPP, and the Congestion Assessment and Resource Integration Study (CARIS). Each CSPP cycle begins with the LTPP. As part of the LTPP, local Transmission Owners perform transmission studies for their BPTFs in their transmission areas according to all applicable criteria. Links to the Transmission Owner's LTPs can be found on the NYISO's website. The LTPP provides inputs for the NYISO's reliability planning process. During the RPP process, the NYISO conducts the Reliability Needs Assessment (RNA) and Comprehensive Reliability Plan (CRP). The RNA evaluates the adequacy and security of the bulk power system over a 10-year study period. In identifying resource adequacy needs, the NYISO identifies the amount of resources in megawatts (known as "compensatory megawatts") and the locations in which they are needed to meet those needs. After the RNA is complete, the NYISO requests and evaluates market-based solutions, regulated backstop solutions and alternative regulated solutions that address the identified Reliability Needs. This step results in the development of the NYISO's CRP for the 10-year study period. The CRP provides inputs for the NYISO's economic planning process known as CARIS. CARIS Phase 1 examines congestion on the New York bulk power system and the costs and benefits of alternatives to alleviate that congestion. During CARIS Phase 2, the NYISO will evaluate specific transmission project proposals for regulated cost recovery.

The NYISO's reliability planning process is a long-range assessment of both resource adequacy and transmission reliability of the New York bulk power system conducted over a 10-year planning horizon. There are two different aspects to analyzing the bulk power system's reliability in the RNA: adequacy and security. Adequacy is a planning and probabilistic concept. A system is adequate if the probability of having sufficient transmission and generation to meet expected demand is equal to or less than the system's standard, which is expressed as a loss of load expectation (LOLE). The New York State bulk power system is planned to meet an LOLE that, at any given point in time, is less than or equal to an involuntary load disconnection that is not more frequent than once in every 10 years, or 0.1 days per year. This requirement forms the basis of New York's installed reserve margin (IRM) resource adequacy requirement.

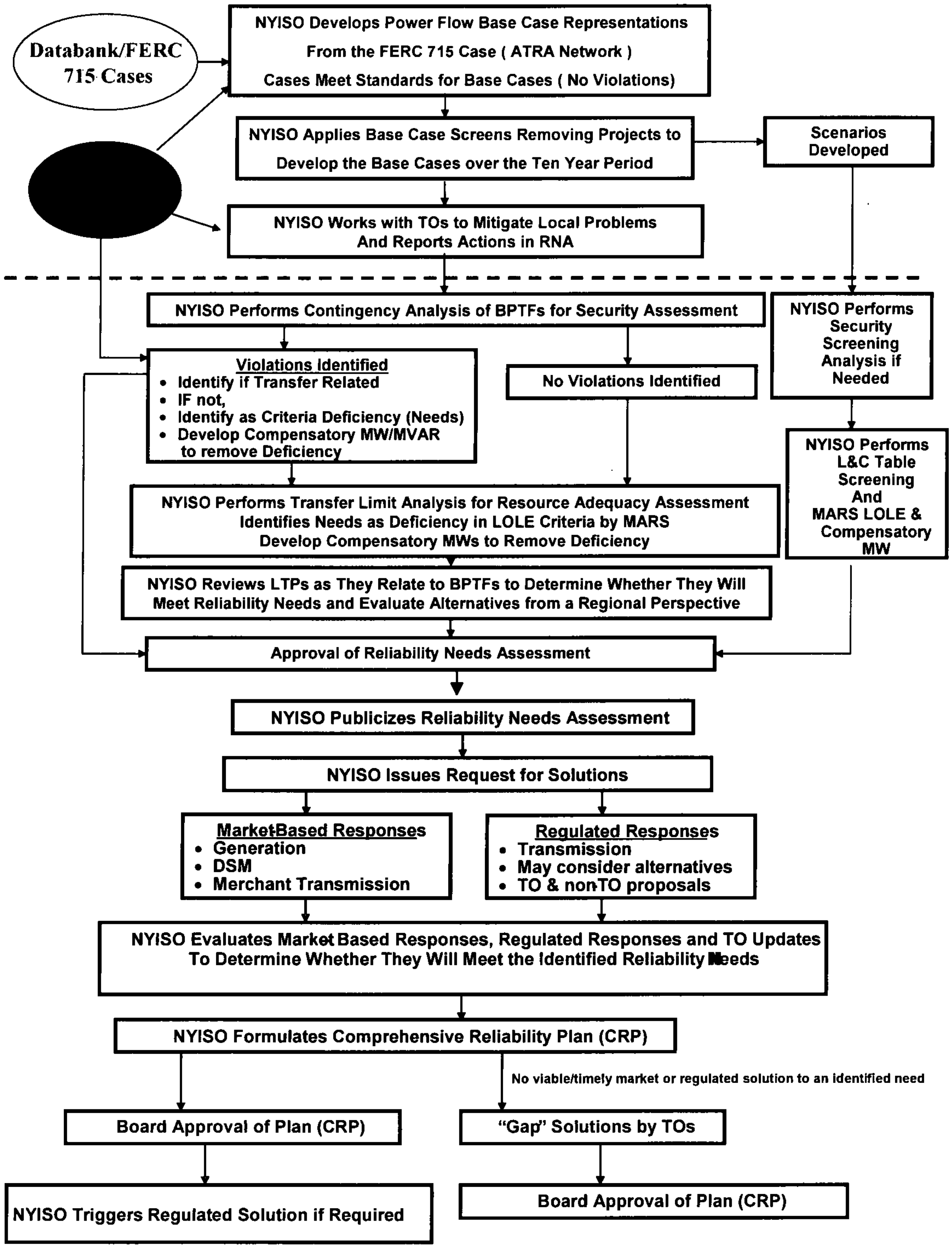
Security is an operating and deterministic concept. This means that possible events are identified as having significant adverse reliability consequences, and the system is planned and operated so that the system can continue to serve load even if these events occur. Security requirements are sometimes referred to as N-1 or N-1-1. N is the number of system components; an N-1 requirement means that the system can withstand single disturbance events (e.g., generator, bus section, transmission circuit, breaker failure, double-circuit tower) without violating thermal, voltage and stability limits or before affecting service to consumers. An N-1-1 requirement means that the Reliability Criteria apply after any critical element such as a generator, a transmission circuit, a transformer, series or shunt compensating device, or a high voltage direct current (HVDC) pole has already been lost. Generation and power flows can be adjusted by the use of 10-minute operating reserve, phase angle regulator control and HVDC control and a second single disturbance is analyzed.

The RPP is anchored in the market-based philosophy of the NYISO and its Market Participants, which posits that market solutions should be the preferred choice to meet the identified Reliability Needs reported in the RNA. In the CRP, the reliability of the bulk power system is assessed and solutions to Reliability Needs evaluated in accordance with existing Reliability Criteria of the North American Electric Reliability Corporation (NERC), the Northeast Power Coordinating Council, Inc. (NPCC), and the New York State Reliability Council (NYSRC) as they may change from time to time. These criteria and a description of the nature of long-term bulk power system planning are described in detail in the applicable planning manual, and are briefly summarized below. In the event that market-based solutions do not materialize to meet a Reliability Need in a timely manner, the NYISO designates the Responsible TO or Responsible TOs or developer of an alternative regulated solution to proceed with a regulated solution in order to maintain system reliability. Under the RPP, the NYISO also has an affirmative obligation to report historic congestion across the transmission system. In addition, the draft RNA is provided to the Market Monitoring Unit for review and consideration of whether market rules changes are necessary to address an identified failure, if any, in one of the NYISO's competitive markets. If market failure is identified as the reason for the lack of market-based solutions, the NYISO will explore appropriate changes in its market rules with its stakeholders and Independent Market Monitor. The RPP does not substitute for the planning that each TO conducts to maintain the reliability of its own bulk and non-bulk power systems.

The NYISO does not license or construct projects to respond to identified Reliability Needs reported in the RNA. The ultimate approval of those projects lies with regulatory agencies such as the FERC, the NYDPS, environmental permitting agencies, and local governments. The NYISO monitors the progress and continued viability of proposed market and regulated projects to meet identified needs, and reports its findings in annual plans. Figure B-1 below summarizes the RPP and Figure B-2 summarizes the CARIS which collectively comprise the CSPP process.

The CRP will form the basis for the next cycle of the NYISO's economic planning process. That process will examine congestion on the New York bulk power system and the costs and benefits of alternatives to alleviate that congestion.

NYISO Reliability Planning Process



Appendix C - Load and Energy Forecast 2014-2024

C-1. Summary

In order to perform the 2014 RNA, a forecast of summer and winter peak demands and annual energy requirements was produced for the years 2014 - 2024. The electricity forecast is based on projections of New York's economy performed by Moody's Analytics in January 2014. The forecast includes detailed projections of employment, output, income and other factors for twenty three regions in New York State. This appendix provides a summary of the electric energy and peak demand forecasts and the key economic input variables used to produce the forecasts. Table C-1 provides a summary of key economic and electric system growth rates from 2003 to 2024.

In June 2008, the New York Public Service Commission issued its Order regarding the Energy Efficiency Portfolio Standard. This proceeding set forth a statewide goal of a cumulative energy reduction of about 26,900 GWh. The NYISO estimates the peak demand impacts to be about 5500 MW. This goal is expected to be achieved by contributions from a number of state agencies, power authorities and utilities, as well as from federal codes and building standards.

Table C-1: Summary of Economic & Electric System Growth Rates – Actual & Forecast

	Average Annual Growth			
	2003-2008	2008-2013	2014-2019	2019-2024
Total Employment	0.70%	0.52%	0.93%	0.21%
Gross State Product	1.58%	1.85%	2.47%	1.75%
Population	0.08%	0.34%	0.19%	0.14%
Total Real_Income	2.53%	1.59%	2.77%	2.25%
Weather Normalized Summer Peak	1.40%	-0.10%	1.04%	0.63%
Weather Normalized Annual Energy	1.11%	-0.36%	0.14%	0.17%

C-2. Historic Overview

The New York Control Area (NYCA) is a summer peaking system and its summer peak has grown faster than annual energy and winter peak over this period. Both summer and winter peaks show considerable year-to-year variability due to the influence of peak-producing weather conditions for the seasonal peaks. Annual energy is influenced by weather conditions over the entire year, which is much less variable than peak-producing conditions.

Table C-2 shows the NYCA historic seasonal peaks and annual energy growth since 2001. The table provides both actual results and weather-normalized results, together with annual average growth rates for each table entry. The growth rates are averaged over the period 2003 to 2013.

Table C-2: Historic Energy and Seasonal Peak Demand - Actual and Weather-Normalized

	Annual Energy - GWh		Summer Peak - MW		Winter Peak - MW		
Year	Actual	Weather Normalized	Actual	Weather Normalized	Year	Actual	Weather Normalized
2003	158,130	157,523	30,333	31,410	2003-04	25,262	24,849
2004	160,211	160,832	28,433	31,401	2004-05	25,541	25,006
2005	167,207	163,015	32,075	33,068	2005-06	24,947	24,770
2006	162,237	163,413	33,939	32,992	2006-07	25,057	25,030
2007	167,339	166,173	32,169	33,444	2007-08	25,021	25,490
2008	165,613	166,468	32,432	33,670	2008-09	24,673	25,016
2009	158,777	161,908	30,844	33,063	2009-10	24,074	24,537
2010	163,505	161,513	33,452	32,458	2010-11	24,654	24,452
2011	163,330	162,628	33,865	33,019	2011-12	23,901	24,630
2012	162,843	163,458	32,547	33,106	2012-13	24,658	24,630
2013	163,493	163,473	33,956	33,502	2013-14	25,738	24,610
	0.33%	0.37%	1.13%	0.65%		0.19%	-0.10%

C-3. Forecast Overview

Table C-3 shows historic and forecast growth rates of annual energy for the different regions in New York. The Upstate region includes Zones A – I. The NYCA's two locality zones, Zones J (New York City) and K (Long Island) are shown individually.

Table C-3: Annual Energy and Summer Peak Demand - Actual & Forecast

	Annual Energy - GWh				Summer Coincident Peak - MW			
Year	Upstate Region	J	K	NYCA	Upstate Region	J	K	NYCA
2003	85,223	50,829	21,960	158,012	15,100	10,240	4,993	30,333
2004	85,935	52,073	22,203	160,211	14,271	9,742	4,420	28,433
2005	90,253	54,007	22,948	167,208	16,029	10,810	5,236	32,075
2006	86,957	53,096	22,185	162,238	17,054	11,300	5,585	33,939
2007	89,843	54,750	22,748	167,341	15,824	10,970	5,375	32,169
2008	88,316	54,835	22,461	165,612	16,223	10,979	5,231	32,433
2009	83,788	53,100	21,892	158,780	15,416	10,366	5,063	30,845
2010	85,469	55,114	22,922	163,505	16,408	11,213	5,832	33,453
2011	86,566	54,059	22,704	163,329	16,558	11,374	5,935	33,867
2012	87,051	53,487	22,302	162,840	16,608	10,722	5,109	32,439
2013	88,084	53,316	22,114	163,514	16,847	11,456	5,653	33,956
2014	87,456	53,498	22,207	163,161	16,621	11,643	5,402	33,666
2015	87,602	53,284	22,328	163,214	16,711	11,907	5,448	34,066
2016	87,983	53,402	22,522	163,907	16,850	12,070	5,492	34,412
2017	87,870	53,144	22,590	163,604	16,996	12,238	5,532	34,766
2018	87,987	53,046	22,720	163,753	17,120	12,421	5,570	35,111
2019	88,515	52,940	22,850	164,305	17,296	12,549	5,609	35,454
2020	89,089	52,969	23,043	165,101	17,369	12,638	5,649	35,656
2021	88,993	52,727	23,110	164,830	17,453	12,747	5,690	35,890
2022	89,113	52,622	23,240	164,975	17,560	12,836	5,731	36,127
2023	89,222	52,517	23,370	165,109	17,647	12,945	5,777	36,369
2024	89,600	52,556	23,565	165,721	17,730	13,029	5,821	36,580
2003-13	0.3%	0.5%	0.1%	0.3%	1.1%	1.1%	1.2%	1.1%
2014-24	0.2%	-0.2%	0.6%	0.2%	0.6%	1.1%	0.7%	0.8%
2003-08	0.7%	1.5%	0.5%	0.9%	1.4%	1.4%	0.9%	1.3%
2008-13	-0.1%	-0.6%	-0.3%	-0.3%	0.8%	0.9%	1.6%	0.9%
2014-19	0.2%	-0.2%	0.6%	0.1%	0.8%	1.5%	0.8%	1.0%
2019-24	0.2%	-0.1%	0.6%	0.2%	0.5%	0.8%	0.7%	0.6%

C-4. Forecast Methodology

The NYISO methodology for producing the long term forecasts for the Reliability Needs Assessment consists of the following steps.

Econometric forecasts were developed for zonal energy using monthly data from 2000 through 2013. For each zone, the NYISO estimated an ensemble of econometric models using population, households, economic output, employment, cooling degree days and heating degree days. Each member of the ensemble was evaluated and compared to historic data. The zonal model chosen for the forecast was the one which best represented recent history and the regional growth for that zone. The NYISO also received and evaluated forecasts from Con Edison and LIPA, which were used in combination with the forecasts we developed for Zones H, I, J and K.

The summer & winter non-coincident and coincident peak forecasts for Zones H, I, J and K were derived from the forecasts submitted to the NYISO by Con Edison and LIPA. For the remaining zones, the NYISO derived the summer and winter coincident peak demands from the zonal energy forecasts by using average zonal weather-normalized load factors from 2000 through 2013. The 2014 summer peak forecast was matched to coincide with the 2014 ICAP forecast.

C-4.1. Demand Side Initiatives

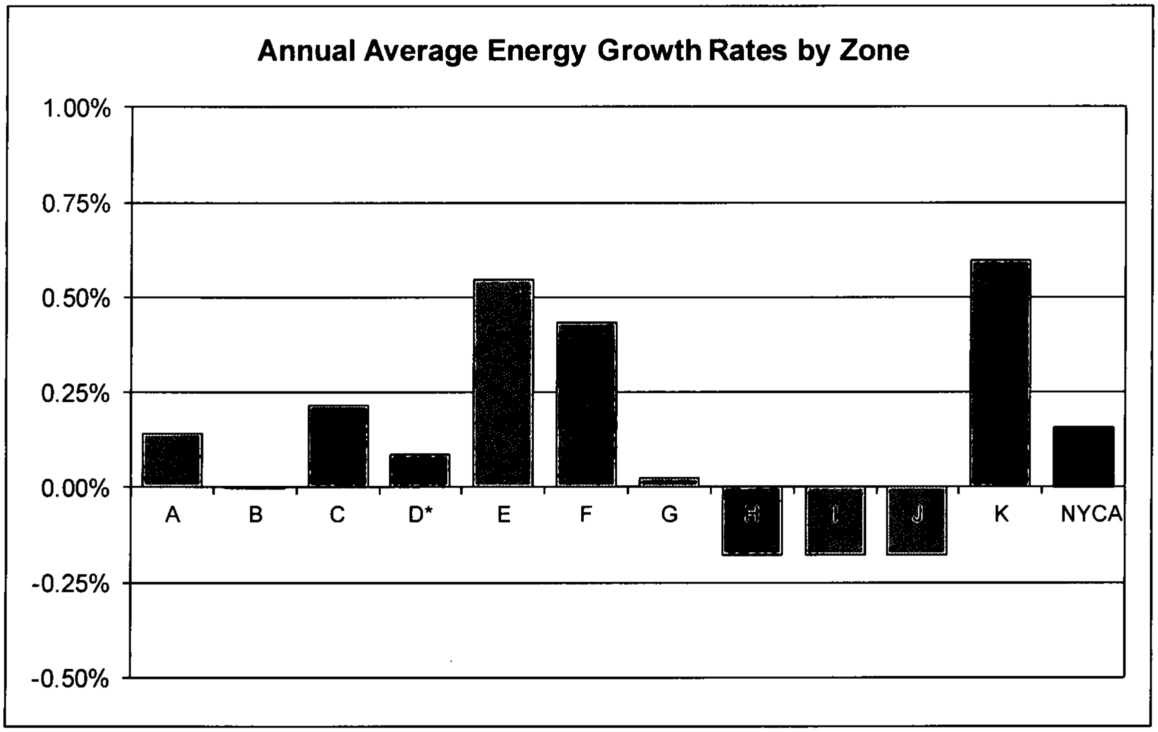
The Energy Efficiency Portfolio Standard (EEPS) is an initiative of the Governor of New York and implemented by the state's Public Service Commission. The goal of the initiative is to reduce electric energy usage by 15 percent from 2007 forecasted energy usage levels in the year 2015 (the 15x15 initiative), for a reduction of 26,880 GWh by 2015.

The NYS PSC directed a series of working groups composed of all interested parties to the proceeding to obtain information needed to further elaborate the goal. The NYS PSC issued an Order in June 2008, directing NYSERDA and the state's investor owned utilities to develop conservation plans in accordance with the EEPS goal. The NYS PSC also identified goals that it expected would be implemented by LIPA and NYPA.

The NYISO has been a party to the EEPS proceeding from its inception. As part of the development of the 2014 RNA forecast, the NYISO developed an adjustment to the 2014 econometric model that incorporated a portion of the EEPS goal. This was based upon discussion with market participants in the Electric System Planning Working Group. The NYISO considered the following factors in developing the 2014 RNA base case:

- NYS PSC-approved spending levels for the programs under its jurisdiction, including the Systems Benefit Charge and utility-specific programs
- Expected realization rates, participation rates and timing of planned energy efficiency programs
- Degree to which energy efficiency is already included in the NYISO's econometric energy forecast
- Impacts of new appliance efficiency standards, and building codes and standards
- Specific energy efficiency plans proposed by LIPA, NYPA and Consolidated Edison Company of New York, Inc. (Con Edison)
- The actual rates of implementation of EEPS based on data received from Department of Public Service staff
- Projected impact of customer-sited solar photovoltaic installations

Once the statewide energy and demand impacts were developed, zonal level forecasts were produced for the econometric forecast and for the base case.



* Zone D's average energy and peak demand growth is based on the last four years of the forecast, after industrial load in this zone is expected to return from a curtailment.

Figure C-1: Zonal Energy Forecast Growth Rates - 2014 to 2024

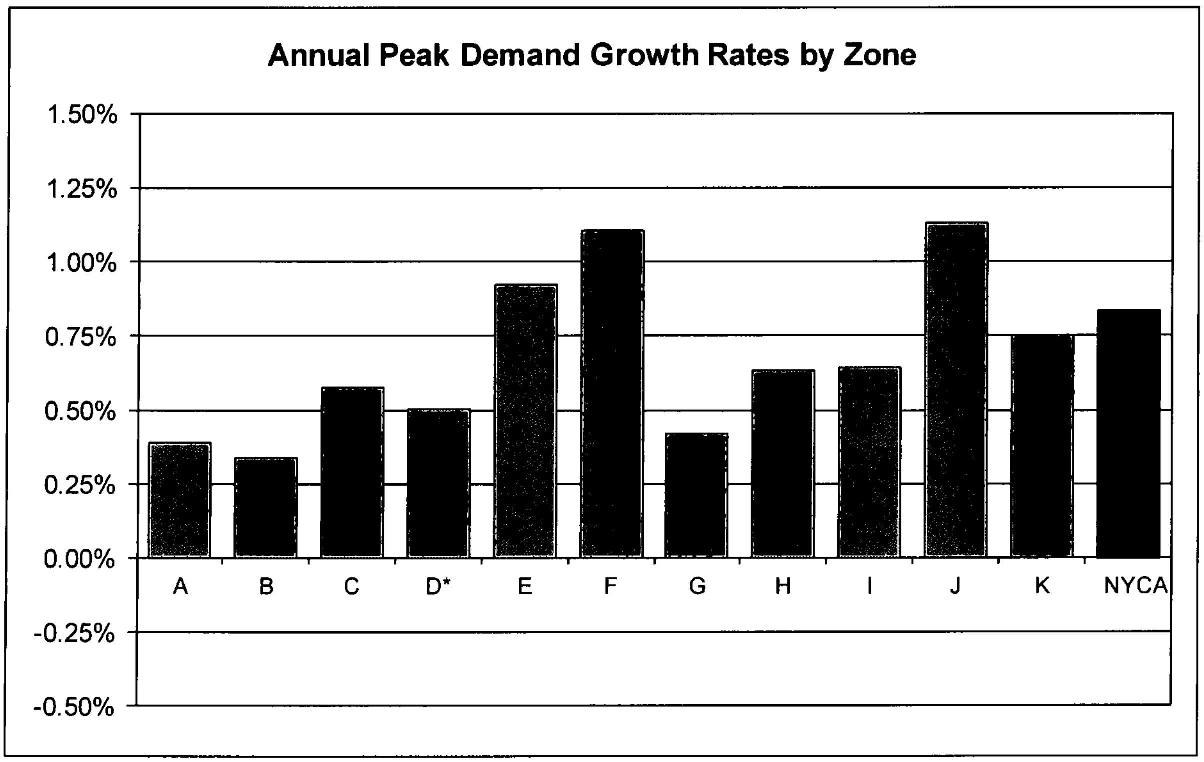


Figure C-2: Zonal Summer Peak Demand Forecast Growth Rates - 2014 to 2024

Table C-4: Annual Energy by Zone – Actual & Forecast (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2003	15,942	9,719	16,794	5,912	6,950	11,115	10,451	2,219	6,121	50,829	21,960	158,012
2004	16,102	9,888	16,825	5,758	7,101	11,161	10,696	2,188	6,216	52,073	22,203	160,211
2005	16,498	10,227	17,568	6,593	7,594	11,789	10,924	2,625	6,435	54,007	22,948	167,208
2006	15,998	10,003	16,839	6,289	7,339	11,337	10,417	2,461	6,274	53,096	22,185	162,238
2007	16,258	10,207	17,028	6,641	7,837	11,917	10,909	2,702	6,344	54,750	22,748	167,341
2008	15,835	10,089	16,721	6,734	7,856	11,595	10,607	2,935	5,944	54,835	22,461	165,612
2009	15,149	9,860	15,949	5,140	7,893	10,991	10,189	2,917	5,700	53,100	21,892	158,780
2010	15,903	10,128	16,209	4,312	7,906	11,394	10,384	2,969	6,264	55,114	22,922	163,505
2011	16,017	10,040	16,167	5,903	7,752	11,435	10,066	2,978	6,208	54,059	22,704	163,329
2012	15,595	10,009	16,117	6,574	7,943	11,846	9,938	2,930	6,099	53,487	22,302	162,840
2013	15,790	9,981	16,368	6,448	8,312	12,030	9,965	2,986	6,204	53,316	22,114	163,514
2014	15,837	10,011	16,342	6,027	8,153	11,993	9,979	2,957	6,157	53,498	22,207	163,161
2015	15,870	10,005	16,372	6,042	8,167	12,043	10,025	2,946	6,132	53,284	22,328	163,214
2016	15,942	10,025	16,441	6,072	8,214	12,128	10,062	2,953	6,146	53,402	22,522	163,907
2017	15,913	9,993	16,423	6,066	8,233	12,148	10,040	2,938	6,116	53,144	22,590	163,604
2018	15,925	9,988	16,447	6,075	8,277	12,201	10,038	2,931	6,105	53,046	22,720	163,753
2019	15,942	9,985	16,475	6,493	8,319	12,256	10,026	2,927	6,092	52,940	22,850	164,305
2020	16,012	10,009	16,553	6,721	8,395	12,334	10,042	2,927	6,096	52,969	23,043	165,101
2021	15,988	9,980	16,546	6,711	8,431	12,345	10,008	2,916	6,068	52,727	23,110	164,830
2022	15,998	9,979	16,583	6,717	8,480	12,391	9,999	2,910	6,056	52,622	23,240	164,975
2023	16,007	9,979	16,615	6,722	8,524	12,439	9,989	2,903	6,044	52,517	23,370	165,109
2024	16,060	10,009	16,696	6,744	8,608	12,525	10,004	2,905	6,049	52,556	23,565	165,721

Table C-5: Summer Coincident Peak Demand by Zone – Actual & Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2003	2,510	1,782	2,727	671	1,208	2,163	2,146	498	1,395	10,240	4,993	30,333
2004	2,493	1,743	2,585	644	1,057	1,953	2,041	475	1,280	9,742	4,420	28,433
2005	2,726	1,923	2,897	768	1,314	2,164	2,236	592	1,409	10,810	5,236	32,075
2006	2,735	2,110	3,128	767	1,435	2,380	2,436	596	1,467	11,300	5,585	33,939
2007	2,592	1,860	2,786	795	1,257	2,185	2,316	595	1,438	10,970	5,375	32,169
2008	2,611	2,001	2,939	801	1,268	2,270	2,277	657	1,399	10,979	5,231	32,433
2009	2,595	1,939	2,780	536	1,351	2,181	2,159	596	1,279	10,366	5,063	30,845
2010	2,663	1,985	2,846	552	1,437	2,339	2,399	700	1,487	11,213	5,832	33,453
2011	2,556	2,019	2,872	776	1,447	2,233	2,415	730	1,510	11,374	5,935	33,867
2012	2,743	2,107	2,888	774	1,420	2,388	2,242	653	1,393	10,722	5,109	32,439
2013	2,549	2,030	2,921	819	1,540	2,392	2,358	721	1,517	11,456	5,653	33,956
2014	2,674	2,054	2,896	703	1,434	2,374	2,290	689	1,507	11,643	5,402	33,666
2015	2,688	2,062	2,916	705	1,449	2,405	2,309	684	1,493	11,907	5,448	34,066
2016	2,710	2,077	2,942	707	1,464	2,437	2,324	688	1,501	12,070	5,492	34,412
2017	2,733	2,093	2,972	710	1,483	2,475	2,336	688	1,506	12,238	5,532	34,766
2018	2,748	2,103	2,993	715	1,499	2,503	2,347	694	1,518	12,421	5,570	35,111
2019	2,756	2,110	3,009	789	1,512	2,529	2,355	702	1,534	12,549	5,609	35,454
2020	2,763	2,112	3,020	793	1,523	2,547	2,363	706	1,542	12,638	5,649	35,656
2021	2,769	2,115	3,033	797	1,536	2,570	2,370	709	1,554	12,747	5,690	35,890
2022	2,773	2,117	3,044	801	1,547	2,595	2,377	724	1,582	12,836	5,731	36,127
2023	2,777	2,121	3,055	805	1,558	2,624	2,383	730	1,594	12,945	5,777	36,369
2024	2,780	2,124	3,067	809	1,572	2,649	2,388	734	1,607	13,029	5,821	36,580

Table C-6: Winter Coincident Peak Demand by Zone – Actual & Forecast (MW)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2003-04	2,433	1,576	2,755	857	1,344	1,944	1,720	478	981	7,527	3,647	25,262
2004-05	2,446	1,609	2,747	918	1,281	1,937	1,766	474	939	7,695	3,729	25,541
2005-06	2,450	1,544	2,700	890	1,266	1,886	1,663	515	955	7,497	3,581	24,947
2006-07	2,382	1,566	2,755	921	1,274	1,888	1,638	504	944	7,680	3,505	25,057
2007-08	2,336	1,536	2,621	936	1,312	1,886	1,727	524	904	7,643	3,596	25,021
2008-09	2,274	1,567	2,533	930	1,289	1,771	1,634	529	884	7,692	3,570	24,673
2009-10	2,330	1,555	2,558	648	1,289	1,788	1,527	561	813	7,562	3,443	24,074
2010-11	2,413	1,606	2,657	645	1,296	1,825	1,586	526	927	7,661	3,512	24,654
2011-12	2,220	1,535	2,532	904	1,243	1,765	1,618	490	893	7,323	3,378	23,901
2012-13	2,343	1,568	2,672	954	1,348	1,923	1,539	510	947	7,456	3,399	24,658
2013-14	2,358	1,645	2,781	848	1,415	1,989	1,700	625	974	7,810	3,594	25,738
2014-15	2,382	1,575	2,608	858	1,323	1,905	1,554	538	935	7,529	3,530	24,737
2015-16	2,391	1,577	2,615	860	1,325	1,914	1,564	538	934	7,537	3,540	24,795
2016-17	2,399	1,580	2,621	863	1,327	1,925	1,568	540	939	7,544	3,550	24,856
2017-18	2,406	1,583	2,628	862	1,332	1,935	1,572	539	937	7,552	3,560	24,906
2018-19	2,413	1,587	2,636	863	1,338	1,947	1,576	540	937	7,559	3,570	24,966
2019-20	2,423	1,591	2,645	934	1,345	1,961	1,580	540	938	7,567	3,580	25,104
2020-21	2,433	1,596	2,654	937	1,355	1,972	1,583	542	941	7,574	3,590	25,177
2021-22	2,444	1,602	2,667	936	1,365	1,985	1,589	542	940	7,582	3,600	25,252
2022-23	2,455	1,608	2,679	936	1,377	2,000	1,597	542	940	7,590	3,610	25,334
2023-24	2,468	1,617	2,692	937	1,389	2,017	1,607	542	941	7,597	3,620	25,427
2024-25	2,484	1,628	2,709	939	1,402	2,037	1,618	543	942	7,605	3,630	25,537

Appendix D - Transmission System Security and Resource Adequacy Assessment

The analysis performed during the Reliability Needs Assessment requires the development of base cases for transmission security analysis and for resource adequacy analysis. The power flow system model is used for transmission security assessment and the development of the transfer limits to be implemented in the Multi-Area Reliability Simulation (MARS) model. A comprehensive assessment of the transmission system is conducted through a series of steady-state power flow, transient stability, and short circuit studies.

In general, the RNA analyses indicated that the bulk power transmission system can be secured under N-1 conditions, but that transfer limits for certain key interfaces must be reduced below their thermal limits, in order to respect voltage criteria. However, a reduction in transfer limits on a limiting interface can result in higher LOLE, and/or needs occurring earlier than they otherwise would. To quantify this potential impact, LOLE analysis was conducted for the RNA base case, a case modeling voltage limited interfaces using the higher thermal limits (NYCA Thermal), and also a case without any internal NYCA transmission limits (NYCA Free Flow). These cases were simulated to demonstrate the impact that transmission limits have on the LOLE results. The results from this analysis are reported in Table 4-7.

The MARS model was used to determine whether adequate resources would be available to meet the NYSRC and NPCC reliability criteria of one day in ten years (0.1 days/year). The results showed a deficiency in years 2019 – 2024 (See Section 4.2.3 of this report.) The MARS model was also used to evaluate selected scenarios (Section 4.3) and it was used to determine compensatory MW requirements for identified Reliability Needs (See Section 4.2.5).

D-1 2014 RNA Assumption Matrix

D-1.1 Assumption Matrix for Resource Adequacy Assessment

Parameter	2014 IRM Model Assumptions Recommended	Basis for IRM Recommendation	2014 RNA Model Change
Load Parameters			
Peak Load	October 1 , 2013 forecast: NYCA 33,655 MW, NYC 11,740 MW, LI 5,461 MW	Forecast based on examination of 2013 weather normalized peaks. Top three external Area peak days aligned with NYCA	2014 Gold Book, NYCA loads similar to Oct 2013 forecast, NYC and LI lower
Load Shape	Multiple Load Shapes Model using years 2002, 2006, and 2007	See white paper	Same, Multiple Load Shapes Model using years 2002, 2006, and 2007
Load Forecast Uncertainty	Zonal model updated to reflect current data	Based on collected data and input from LIPA, Con Ed, and NYISO. (See attachment A)	Same
Capacity Parameters			
Existing Generating Unit Capacities	2013 Gold Book values. Use min (DMNC vs. CRIS) capacity value	2013 Gold Book publication	2014 Gold Book, capacity similar to 2013 Gold Book
Proposed New Non-Wind Units	76.9 MW of capacity was repowered or returned to service (see Attachment B)	Units built since the 2013 Gold Book and those non-renewable units with Interconnection Agreements signed by August 1.	Consistent with Inclusion Rules, capacity repowered or returned to service plus Taylor Biomass included in the base case
Retirement Units*	164 MW retirements reported, See Attachment B3	Policy 5 guidelines on retirement disposition in IRM studies	2014 Gold Book Section IV, not modeled in the base case
Mothball Units*			2014 Gold Book Section IV, Cayuga modeled 2015 and 2016 only. Not modeled in the base case: Dunkirk 1, 2, 3, and 4, 9/10/2012, TC Ravenswood GT 7, 3/13/2014, and Selkirk I & II, 9/1/2014
ICAP Ineligible Forced Outage Units			N/A
Forced Outage Units			Modeled in the base case with EFOR reflecting the outage
Forced and Partial Outage Rates	Five-year (2008-2012) GADS data for each unit represented. Those units with less than five years – use representative data. See attachments C and C1	T. Rates representing the Equivalent Forced Outage Rates (EFORd) during demand periods over the most recent five-year period (2008-2012)	Update for most recent five year period, 2009-2013
Planned Outages	Based on schedules received by the NYSIO and adjusted for history	Updated schedules, currently, data from last year is being used	Same

Parameter	2014 IRM Model Assumptions Recommended	Basis for IRM Recommendation	2014 RNA Model Change
Summer Maintenance	Nominal 50 MW – divided equally between upstate and downstate	Review of most recent data	Same
Combustion Turbine Derates	Derates based on temperature correction curves provided	Operational history indicates the derates are in-line with manufacturer's curves	Same
Proposed New Wind Units	No new wind, See Attachment B1	Renewable units based on RPS agreements, interconnection Queue and ICS input	2014 Gold Book IV, no new wind units
Wind Resources	Wind Capacity – 1366.6 MW	Number decrease due to a (2013 IRM) forecast not participating in NY Capacity market (Marble River Wind).	2014 Gold Book Section III and IV
Wind Shape	Actual hourly plant output of the 2012 calendar year. Summer Peak Hour availability of 17%	Testing results and White Paper	Same
Solar Resources	Solar Capacity of 31.5 MW plus 12.5 MW of new units. See Attachment B-2	Based on collected hourly solar data, Summer Peak Hour capacity factor based on June 1 – Aug 31, hours HB14 – HB18	2014 Gold Book, as reflected in Load Forecast
Non-NYPA Hydro Resources	Derated by 45%	Review of unit production and hydrological conditions including recognized forecasts (i.e. NOAA)	Same
Capacity Purchases	Grandfathered amounts: PJM – 1080 MW, HQ – 1090 MW, All contracts model as equivalent contracts	Grandfathered Rights, ETCNL, and other FERC identified rights	Modeled same as in 2012 RNA
Capacity Sales	Long Term firm sales (279 MW)	These are long term federally monitored contracts	
UDRs	No new UDRs		Updated to most current UDRs
Topology Parameters			
Interface Limits	All changes reviewed and commented on by TPAS. See Attachment E.	Based on 2013 Operating Study, 2013 Operations Engineering Voltage Studies, 2013 Comprehensive Planning Process, and additional analysis including interregional planning initiatives	updated analysis extended for ten years
New Transmission	None Identified	Based on TO provided models and NYISO review	2014 Gold Book Section VII that are consistent with the inclusion rules Firm projects in-service within three years are modeled, such as TOTS (2016), Five Mile Road (2015), Mainesburg (2015), Farmers Valley (2016), etc.

Parameter	2014 IRM Model Assumptions Recommended	Basis for IRM Recommendation	2014 RNA Model Change
Cable Forced Outage Rates	All existing Cable EFORs updated for NYC and LI to reflect most recent five-year history	Based on TO analysis	Same transition rate as provided by TO and held constant over ten years
Emergency Operating Procedure Parameters			
Special Case Resources	July 2014 – 1195 MW based on registrations and modeled as 758 MW of effective capacity. Monthly variation based on historical experience (no Limit on number of calls)	Those sold for the program discounted to historic availability. Summer values calculated from July 2013 registrations (see attachment F).	2014 Gold Book, registration ICAP is similar to IRM but UCAP is higher
EDRP Resources	July 2013 – 93.9 MW registered model as 12.8 MW in July and proportional to monthly peak load in other months. Limit to five calls per month	Those sold for the program discounted to historic availability. Summer values calculated from July 2013 registrations and forecast growth.	2014 Gold Book, registration ICAP and UCAP are both similar to IRM
Other EOPs	721 MW of non-SCR/non-EDRP resources See Attachment D	Based on TO information, measured data, and NYISO forecasts	Updated as available
External Control Areas Parameters			
PJM	Load and Capacity data provided by PJM/NPCC CP-8, and may be adjusted per NYSRC Policy 5		LOLE adjusted to between 0.1 and 0.15 for every year of ten year period
ISONE	Load and Capacity data provided by PJM/NPCC CP-8, and may be adjusted per NYSRC Policy 5		LOLE adjusted to between 0.1 and 0.15 for every year of ten year period
HQ	Load and Capacity data provided by PJM/NPCC CP-8, and may be adjusted per NYSRC Policy 5		LOLE adjusted to between 0.1 and 0.15 for every year of ten year period
IESO	Load and Capacity data provided by PJM/NPCC CP-8, and may be adjusted per NYSRC Policy 5		LOLE adjusted to between 0.1 and 0.15 for every year of ten year period
Reserve Sharing	All NPCC Control Areas and PJM interconnection indicate that they will share reserves equally among all members	Per NPCC CP-8 WG	Same
Miscellaneous			
MARS Model Version	Version 3.16.5	Per benchmark testing and ICS recommendation	Version 3.18
Environmental Initiatives	No estimated impacts based on review of existing rules and retirement trends	An analysis of generator plans to comply with new regulations in 2014	Updated to most recent NYSDEC BTA determination

*Treatment of retired or mothballed units for purposes of RNA modeling: Any generating units that, pursuant to the PSC Orders in Case 05-E-0889, have provided a notice of Retirement, Mothball, etc., by the study lock-down date, were assumed not to be available for the RNA study period.

D-1.2 Assumption Matrix for Transmission Security Assessment

Parameter	Modeling Assumptions	Source
Peak Load	NYCA baseline coincident summer peak forecast	2014 Gold Book
Load model	ConEd: voltage varying	2014 FERC 715 filing
	Rest of NYCA: constant power	
System representation	Per updates received through Databank process (Subject to RNA base case inclusion rules)	NYISO RAD Manual, 2014 FERC 715 filing
Inter-area interchange schedules	Consistent with ERAG MMWG interchange schedule	2014 FERC 715 filing, MMWG
Inter-area controllable tie schedules	Consistent with applicable tariffs and known firm contracts or rights	2014 FERC 715 filing
In-city series reactors	Consistent with ConEdison operating protocol (All series reactors in-service for summer)	2014 FERC 715 filing, ConEd protocol
SVCs, FACTS	Set at zero pre-contingency; allowed to adjust post-contingency	NYISO T&D Manual
Transformer & PAR taps	Taps allowed to adjust pre-contingency; fixed post-contingency	2014 FERC 715 filing
Switched shunts	Allowed to adjust pre-contingency; fixed post-contingency	2014 FERC 715 filing
Fault current analysis settings	Per Fault Current Assessment Guideline	NYISO Fault Current Assessment Guideline
Model Version	Power flow: PSS/E v32.2.1, PSS/MUST v11.0, TARA v735	
	Dynamics: PSS/E v32.2.1	
	Short Circuit: ASPEN v12.2	

D-2 RNA Power Flow Base Case Development and Thermal Transfer Limit Results

D- 2.1 Development of RNA Power Flow Base Cases

The base cases used in analyzing the performance of the transmission system were developed from the 2014 FERC 715 filing power flow case library. The load representation in the power flow model is the summer peak load forecast reported in the 2014 Gold Book Table 1-2a baseline forecast of coincident peak demand. The system representation for the NPCC Areas in the base cases is from the 2013 Base Case Development (BCD) libraries compiled by the NPCC SS-37 Base Case Development working group. The PJM system representation was derived from the PJM Regional Transmission Expansion Plan (RTEP) planning process models. The remaining models are from the Eastern Interconnection Reliability Assessment Group (ERAG) Multiregional Modeling Working Group (MMWG) 2013 power flow model library.

The 2014 RNA base case model of the New York system representation includes the following new and proposed facilities:

1. TO LTPs for non-bulk transmission facilities and NYPA transmission plans for non-bulk power facilities which are reported to the NYISO as firm transmission plans will be included,
2. TO bulk power system projects not in-service or under construction will be included if:
   a. the project is the regulated solution triggered in a prior year, or
   b. the project is required in connection with any projects and plans that are included in the Study Period base case, or
   c. the project is part of a TO LTP or the NYPA transmission plan, and reported to the NYISO as a firm transmission plan(s), and is expected to be in service within 3 years, and has an approved SRIS or an approved SIS (as applicable), and has received NYPSC certification (or other required regulatory approvals and reviews).
3. Other projects that are in-service or under construction will be included,
4. Other projects not already in-service or under construction will be included and modeled at the contracted-for capacity if they have:
   a. an approved SRIS or an approved SIS (as applicable), and
   b. a NYPSC certificate, or other required regulatory approvals and complete review under the State Environmental Quality Review Act ("SEQRA") where the NYPSC siting process is not applicable, and
   c. an executed contract with a credit worthy entity for at least half of the project capacity.

The RNA base case does not include all projects currently listed on the NYISO's interconnection queue or those shown in the 2014 Gold Book. It includes only those which meet the screening requirements for inclusion. The firm transmission plans included in 2014 RNA base case are included in Table D-1 below.

Table D-1: Firm Transmission Plans included in 2014 RNA Base Case

Transmission Owner	Terminals		Line Length in Miles	Expected In-Service Date/Yr		Nominal Voltage in kV		# of ckts	Thermal Ratings		Project Description / Conductor Size	Class Year / Type of Construction
				Prior to	Year	Operating	Design		Summer	Winter		
CHGE	North Catskill	Feura Bush	Series Reactor	S	2014	115	115	1	1280	1560	Reactor impedance increase from 12% to 16%	-
CHGE	Pleasant Valley	Todd Hill	5.53	W	2015	115	115	1	1280	1563	Rebuild line with 1033 ACSR	OH
CHGE	Todd Hill	Fishkill Plains	5.23	W	2015	115	115	1	1280	1563	Rebuild line with 1033 ACSR	OH
CHGE	Hurley Ave	Saugerties	11.40	S	2020	115	115	1	1114	1359	1-795 ACSR	OH
CHGE	Saugerties	North Catskill	12.46	S	2020	115	115	1	1114	1359	1-795 ACSR	OH
CHGE	St. Pool	High Falls	5.61	S	2020	115	115	1	1114	1359	1-795 ACSR	OH
CHGE	High Falls	Kerhonkson	10.03	S	2020	115	115	1	1114	1359	1-795 ACSR	OH
CHGE	Kerhonkson	Honk Falls	4.97	S	2020	115	115	2	1114	1359	1-795 ACSR	OH
CHGE	Modena	Galeville	4.62	S	2020	115	115	1	1114	1359	1-795 ACSR	OH
CHGE	Galeville	Kerhonkson	8.96	S	2020	115	115	1	1114	1359	1-795 ACSR	OH
ConEd	Dunwoodie South	Dunwoodie South	Phase shifter	S	2014	138	138	2	Nominal 132 MVA		PAR Retirement	-
ConEd	Dunwoodie South	Dunwoodie South	Phase shifter	S	2014	138	138	1	Nominal 300 MVA		PAR Replacement	-
ConEd	Goethals	Goethals	Reconfiguration	S	2014	345	345		N/A	N/A	Reconfiguration	-
ConEd	Rock Tavern	Sugarloaf	13.70	S	2016	345	345	1	1811 MVA	1918 MVA	2-1590 ACSR	OH
ConEd	Goethals	Gowanus	12.95	S	2016	345	345	2	632 MVA	679 MVA	Additional Cooling	UG
ConEd	Gowanus	Farragut	4.05	S	2016	345	345	2	800 MVA	844 MVA	Additional Cooling	UG
ConEd	Goethals	Linden Co-Gen	-1.50	S	2016	345	345	1	2504	2504	Feeder Seperation	UG
ConEd	Goethals	Linden Co-Gen	1.50	S	2016	345	345	1	1252	1252	Feeder Seperation	UG
ConEd	Goethals	Linden Co-Gen	1.50	S	2016	345	345	1	1252	1252	Feeder Seperation	UG
ConEd	Greenwood	Greenwood	Reconfiguration	S	2018	138	138		N/A	N/A	Reconfiguration	-
LIPA	Holtsville DRSS	West Bus	N/A	S	2014	138	138	-	150 MVAR	150 MVAR	Dynamic Reactive Support System (DRSS)	
LIPA	Randall Ave	Wildwood	N/A	S	2014	138	138	-	150 MVAR	150 MVAR	Dynamic Reactive Support System (DRSS)	
NGRID	Dunkirk	Dunkirk	Cap Bank	W	2014	115	115	1	67 MVAR	67 MVAR	Capacitor Bank 2 - 33.3 MVAR	-
NGRID	Rome	Rome	-	W	2014	115	115	-	N/A	N/A	Station Rebuild	-
NGRID	Porter	Porter	-	W	2014	115	115	-	N/A	N/A	Rebuild 115kV Station	-
NGRID	Homer City	Stolle Road	-204.11	S	2015	345	345	1	1013	1200	New Five Mile substation	OH
NGRID	Homer City	Five Mile Rd (New Station)	151.11	S	2015	345	345	1	1013	1200	New Five Mile substation	OH
NGRID	Five Mile Rd (New Station)	Stolle Road	53.00	S	2015	345	345	1	1013	1200	New Five Mile substation	OH
NGRID	Gardenville	Homer Hill	-65.69	S	2015	115	115	2	584	708	New Five Mile substation	OH
NGRID	Gardenville	Five Mile Rd (New Station)	58.30	S	2015	115	115	2	129MVA	156MVA	New Five Mile substation	OH
NGRID	Five Mile Rd (New Station)	Five Mile Rd (New Station)	xfmr	S	2015	345/115	345/115	-	478MVA	590MVA	New Five Mile substation	-
NGRID	Five Mile Rd (New Station)	Homer Hill	8.00	S	2015	115	115	2	129MVA	156MVA	New Five Mile substation	OH
NGRID	Clay	Clay	xfmr	S	2015	345/115	345/115	1	478MVA	590MVA	Replace Transformer	-
NGRID	Rotterdam	Bear Swamp	-43.64	S	2015	230	230	1	1105	1284	795 ACSR	OH
NGRID	Rotterdam	Eastover Road (New Station)	23.20	S	2015	230	230	1	1114	1284	Rotterdam-Bear Swamp #E205 Loop (0.8 miles new)	OH
NGRID	Eastover Road (New Station)	Bear Swamp	21.88	S	2015	230	230	1	1105	1347	Rotterdam-Bear Swamp #E205 Loop (0.8 miles new)	OH

Transmission Owner	Terminals		Line Length in Miles	Expected In-Service Date/Yr Prior to	Year	Nominal Voltage in kV Operating	Design	# of ckts	Thermal Ratings Summer	Winter	Project Description / Conductor Size	Class Year / Type of Construction
NGRID	Eastover Road (New Station)	Eastover Road (New Station)	xfmr	S	2015	230/115	230/115	1	345MVA	406MVA	Transformer	-
NGRID	Luther Forest	North Troy	-18.30	S	2015	115	115	1	937	1141	1033.5 ACSR	
NGRID	Luther Forest	Eastover Road (New Station)	17.50	S	2015	115	115	1	937	1141	Luther Forest-North Troy Loop (0.9 miles new)	OH
NGRID	Eastover Road (New Station)	North Troy	2.60	S	2015	115	115	1	937	1141	Luther Forest-North Troy Loop (0.9 miles new)	OH
NGRID	Battenkill	North Troy	-22.39	S	2015	115	115	1	916	1118	605 ACSR	
NGRID	Battenkill	Eastover Road (New Station)	21.59	S	2015	115	115	1	937	1141	Battenkill-North Troy Loop (0.9 miles new)	
NGRID	Eastover Road (New Station)	North Troy	2.60	S	2015	115	115	1	916	1118	Battenkill-North Troy Loop (0.9 miles new)	
NGRID/NYSE	Homer City	Five Mile Rd (New Station)	-151.11	S	2016	345	345	1	1013	1200	New Five Mile substation	OH
NGRID/NYSE	Homer City	Farmers Valley	120.00	S	2016	345	345	1	1013	1200	New Farmer Valley substation	OH
NGRID/NYSE	Farmers Valley	Five Mile Rd (New Station)	31.00	S	2016	345	345	1	1013	1200	New Farmer Valley substation	OH
NGRID	Clay	Dewitt	10.24	W	2017	115	115	1	193MVA	245MVA	Reconductor 4/0 CU to 795ACSR	OH
NGRID	Clay	Teall	12.75	W	2017	115	115	1	220 MVA	239MVA	Reconductor 4/0 CU to 795ACSR	OH
NYPA	Moses	Willis	-37.11	S	2014	230	230	2	876	1121	795 ACSR	OH
NYPA	Moses	Willis	37.11	S	2014	230	230	1	876	1121	795 ACSR	OH
NYPA	Moses	Willis	37.11	S	2014	230	230	1	876	1121	795 ACSR	OH
NYPA	Moses	Moses	Cap Bank	W	2014	115	115	1	100 MVAR	100 MVAR	Cap Bank Installation to Replace Moses Synchronous Condensers	-
NYPA	Moses	Moses	Cap Bank	W	2015	115	115	1	100 MVAR	100 MVAR	Cap Bank Installation to Replace Moses Synchronous Condensers	-
NYPA	Marcy	Coopers Corners	Series Comp	S	2016	345	345	1	1776 MVA	1793 MVA	Installation of Series Compensation on UCC2-41	-
NYPA	Edic	Fraser	Series Comp	S	2016	345	345	1	1793 MVA	1793 MVA	Installation of Series Compensation on EF24-40	-
NYPA	Fraser	Coopers Corners	Series Comp	S	2016	345	345	1	1494 MVA	1793 MVA	Installation of Series Compensation on FCC33	-
NYPA	Niagara	Rochester	-70.20	W	2016	345	345	1	2177	2662	2-795 ACSR	OH
NYPA	Niagara	Station 255 (New Station)	66.40	W	2016	345	345	1	2177	2662	2-795 ACSR	OH
NYPA	Station 255 (New Station)	Rochester	3.80	W	2016	345	345	1	2177	2662	2-795 ACSR	OH
NYPA	Dysinger Tap	Rochester	-44.00	W	2016	345	345	1	2177	2662	2-795 ACSR	OH
NYPA	Dysinger Tap	Station 255 (New Station)	40.20	W	2016	345	345	1	2177	2662	2-795 ACSR	OH
NYPA	Station 255 (New Station)	Rochester	3.80	W	2016	345	345	1	2177	2662	2-795 ACSR	OH
NYSEG	Meyer	Meyer	Cap Bank	S	2014	115	115	1	18 MVAR	18 MVAR	Capacitor Bank Installation	-
NYSEG	Wood Street	Katonah	11.70	W	2014	115	115	1	775	945	477 ACSR	OH
NYSEG	Ashley Road	Ashley Road	Cap Bank	W	2014	115	115	1	150 MVAR	150 MVAR	Capacitor Bank (DOE)	-
NYSEG	Big Tree	Big Tree	Cap Bank	W	2014	115	115	1	50 MVAR	50 MVAR	Capacitor Bank (DOE)	-
NYSEG	Coopers Corners	Coopers Corners	Shunt Reactor	W	2014	345	345	1	200 MVAR	200 MVAR	Shunt Reactor Installation	-
NYSEG	Watercure Road	Watercure Road	xfmr	W	2015	345/230	345/230	1	426 MVA	494 MVA	Transformer	-
NYSEG	Goudey	AES Westover	reconfig	W	2014	115	115	-	N/A	N/A	substation separation	-
NYSEG	Jennison	AES Oneonta	reconfig	W	2014	115	115	-	N/A	N/A	substation separation	-
NYSEG	Homer City	Watercure Road	-177.00	S	2015	345	345	1	1549	1552	2156 ACR	OH
NYSEG	Watercure Road	Mainesburg	26.00	S	2015	345	345	1	1549	1552	2156 ACR	OH
NYSEG	Mainesburg	Homer City	151.00	S	2015	345	345	1	1549	1552	2156 ACR	OH
NYSEG	Wood Street	Carmel	1.34	W	2015	115	115	1	775	945	477 ACSR	OH

Transmission Owner	Terminals		Line Length in Miles	Expected In-Service Date/Yr Prior to	Year	Nominal Voltage in kV Operating	Design	# of ckts	Thermal Ratings Summer	Winter	Project Description / Conductor Size	Class Year / Type of Construction
NYSEG	Carmel	Katonah	13.04	S	2016	115	115	1	1079	1079	convert 46kV to 115kV	OH
NYSEG	Fraser	Coopers Corners	21.80	S	2016	345	345	1	2500	3000	ACCR 1742-T9 Reconductor	OH
NYSEG	Wood Street	Wood Street	xfmr	S	2016	345/115	345/115	1	280 MVA	300 MVA	Transformer	-
NYSEG	Elbridge	State Street	14.50	W	2016	115	115	1	250 MVA	305 MVA	1033 ACSR	OH
NYSEG	Gardenville	Gardenville	xfmr	S	2017	230/115	230/115	1	200 MVA	225 MVA	Transformer	-
NYSEG	Klinekill Tap	Klinekill	<10	W	2017	115	115	1	>=124 MVA	>=150 MVA	477 ACSR	OH
NYSEG	Stephentown	Stephentown	xfmr	W	2017	115/34.5	115/34.5	1	37 MVA	44MVA	Transformer	-
NYSEG	Colliers	Colliers	xfmr	W	2019	115/46	115/46	1	42 MVA	55 MVA	Transformer	-
NYSEG	Colliers	Colliers	xfmr	W	2019	115/46	115/46	1	63 MVA	75 MVA	Transformer	-
NYSEG	Carmel	Carmel	xfmr	W	2019	115/46	115/46	1	80 MVA	96MVA	Transformer	-
O & R	Ramapo	Sugarloaf	16.00	S	2014	138	345	1	1089	1298	2-1590 ACSR	OH
O & R	New Hempstead	-	Cap Bank	S	2014	138	138	1	32 MVAR	32 MVAR	Capacitor bank	-
O & R	Hartley	-	Cap Bank	S	2014	69	69	1	32 MVAR	32 MVAR	Capacitor bank	-
O & R	Summit (RECO)	-	Cap Bank	W	2015	69	69	1	32 MVAR	32 MVAR	Capacitor bank	-
O & R	Ramapo	Sugarloaf	16.00	S	2016	345	345	1	3030	3210	2-1590 ACSR	OH
O & R	Sugarloaf	Sugarloaf	xfmr	S	2016	345/138	345/138	1	400 MVA	400 MVA	Transformer	OH
O & R	Little Tor	-	Cap Bank	S	2016	138	138	1	32 MVAR	32 MVAR	Capacitor bank	-
O & R	O&R's Line 26	Sterling Forest	xfmr	S	2016	138/69	138/69	1	175 MVA	175 MVA	Transformer	
O & R	Burns	Corporate Drive	5.00	S	2016	138	138	1	1980	2120	1272 ACSS	OH
O & R	Harings Corner (RECO)	Tappan (NY)	-	S	2015	69	69	1	1096	1314	Three-way switch station	OH
O & R	West Nyack (NY)	Harings Corner (RECO)	7.00	W	2019	69	138	1	1604	1723	795 ACSS	OH
O & R	Ramapo	Sugarloaf	17.00	W	2020	138	138	1	1980	2120	1272 ACSS	OH
O & R	Montvale (RECO)	-	Cap Bank	S	2021	69	69	1	32 MVAR	32 MVAR	Capacitor bank	-
RGE	Station 69	Station 69	Cap Bank	S	2014	115	115	1	20 MVAR	20 MVAR	Capacitor Bank (DOE)	
RGE	Station 67	Station 418	3.5	W	2014	115	115	1	1255	1255	New 115kV Line	OH
RGE	Station 251	Station 251	xfmr	W	2014	115/34.5	115/34.5	2	30 MVA	33.8 MVA	Transformer	
RGE	Mortimer	Station 251	1	W	2014	115	115	2	1396	1707	New 115kV Line	OH
RGE	Station 251	Station 33	0.98	W	2014	115	115	2	1396	1707	New 115kV Line	OH
RGE	Station 23	Station 23	xfmr	S	2015	115/34.5	115/34.5	2	75 MVA	84 MVA	Transformer	
RGE	Station 23	Station 23	xfmr	S	2015	15/11.5/11	5/11.5/1	2	75 MVA	84 MVA	Transformer	
RGE	Station 42	Station 23	Phase Shifter	S	2015	115	115	1	253 MVA	285 MVA	Phase Shifter	
RGE	Station 168	Station 168	xfmr	S	2015	115/34.5	115/34.5	1	100 MVA	112 MVA	Transformer	
RGE	Station 262	Station 262	xfmr	S	2015	115/34.5	115/34.5	1	56 MVA	63 MVA	Transformer	
RGE	Station 33	Station 262	2.97	W	2015	115	115	1	2008	2409	Underground Cable	UG
RGE	Station 262	Station 23	1.46	W	2015	115	115	1	2008	2409	Underground Cable	UG
RGE	Station 255 (New Station)	Rochester	3.80	W	2016	345	345	1	2177	2662	2-795 ACSR	OH
RGE	Station 255 (New Station)	Station 255 (New Station)	xfmr	W	2016	345/115	345/115	2	400 MVA	450 MVA	Transformer	
RGE	Station 255 (New Station)	Station 418	9.60	W	2016	115	115	1	1506	1807	New 115kV Line	OH
RGE	Station 255 (New Station)	Station 23	11.10	W	2016	115	115	1	1506	1807	New 115kV Line	OH+UG

D-2.2 Emergency Thermal Transfer Limit Analysis

The NYISO performed analyses of the RNA base case to determine emergency thermal transfer limits for the key interfaces to be used in the MARS resource adequacy analysis. Table D-1 reports the emergency thermal transfer limits for the RNA base system conditions:

Table D-1: Emergency Thermal Transfer Limits

Interface	2015		2016		2017		2018		2019	
Dysinger East	2200	1	2150	1	2100	1	2075	1	2050	1
Volney East	5650	2	5650	2	5650	2	5650	2	5650	2
Moses South	2650	3	2650	3	2650	3	2650	3	2650	3
Central East MARS	4025	4	4500	5	4500	5	4500	5	4500	5
F to G	3475	6	3475	6	3475	6	3475	6	3475	6
UPNY-SENY MARS	5150	6	5600	6	5600	6	5600	6	5600	6
I to J (Dunwoodie South MARS)	4400	7	4400	7	4400	7	4400	7	4400	7
I to K (Y49/Y50)	1290	8	1290	8	1290	8	1290	8	1290	8

	Limiting Facility	Rating	Contingency
1	Huntley-Gardenville 230 kV (80)	755	Huntley-Gardenville 230 kV (79)
2	Oakdale-Fraser 345kV	1380	Edic-Fraser 345kV
3	Marcy 765/345 T2 transformer	1971	Marcy 765/345 T1 transformer
4	New Scotland-Leeds 345kV	1724	New Scotland-Leeds 345kV
5	Porter-Rotterdam 230kV	560	Porter-Rotterdam 230kV
6	Leeds-Pleasant Valley 345 kV	1725	Athens-Pleasant Valley 345 kV
7	Mott Haven-Rainey 345 kV	786	Pre-disturbance
8	Dunwoodie-Shore Rd 345 kV	653	Pre-disturbance

Table D-1a: Dynamic Limit Tables

Year	Interface	Oswego Complex Units*				
		All available	any 1 out	any 2 out	any 3 out	any 4 out
2015	Central East MARS	3250	3200	3140	3035	2920
	CE Group	4800	4725	4640	4485	4310
2016 - 2024	Central East MARS	3100	3050	2990	2885	2770
	CE Group	5000	4925	4840	4685	4510

* 9 Mile Point 1, 9 Mile Point 2, Fitzpatrick, Oswego 5, Oswego 6, Independence (Modeled as one unit in MARS)

Year	Interface	Huntley / Dunkirk Units				
		All available	any 1 out	any 2 out	any 3 out	4 out
2015	Dysinger East	2950	2650	2200	1575	950
	Zone A Group	3450	2850	2300	1550	775
2016	Dysinger East	2900	2600	2150	1525	900
	Zone A Group	3425	2825	2275	1525	750
2017	Dysinger East	2850	2550	2100	1475	850
	Zone A Group	3400	2800	2250	1500	725
2018	Dysinger East	2825	2525	2075	1450	825
	Zone A Group	3375	2775	2225	1475	700
2019	Dysinger East	2800	2500	2050	1425	800
	Zone A Group	3350	2750	2200	1450	675

* Huntley 67, Huntley 68, Dunkirk 3, Dunkirk 4

Year	Interface	Barrett Steam units (1 and 2)		
		Both available	Any 1 out	Both out
2015-2024	LI Sum	297	260	144
	CE-LIPA (towards Zone J)	510	403	283

Year	Interface	Staten Island Units*			
		All available	AK 3 on, and any one of AK 2, Linden Cogen 1 or Linden Cogen 2 out	AK3 out	Any 2 (or more) out
2015	Dummy Zone J3 to J	200	500	700	815

Year	Interface	Staten Island Units*	
		All available	Any out
2016-2024	Dummy Zone J3 to J	600	815

* Arthur Kill 2, Arthur Kill 3, Linden Cogen (Modeled as 2 units in MARS)

Year	Interface	PSEG units*			
		All available	any 1 out	Any 2 out	All out
2015-2024	Dummy Zone J2 to J	1000	600	500	400
	PJM East to Dummy Zone J2	1000	600	500	400

* Hudson 2, Bergen 2 CC, Linden 2 CC (PJM)

Year	Interface	Northport Units	
		All available	Any out
2015-2024	Norwalk CT to K (NNC)	388	428

D-3 2014 RNA MARS Model Base Case Development

The system representation for PJM, Ontario, New England, and Hydro Quebec modeled in the 2014 RNA base case was developed from the NPCC CP-8 2012 Summer Assessment. In order to avoid overdependence on emergency assistance from the external areas, the emergency operating procedure data was removed from the model for each External Area. In addition, the capacity of the external areas was further modified such that the LOLE value of each Area was a minimum value of 0.10 and capped at a value of 0.15 through the year 2024. The external area model was then frozen for the remaining study years (2015 – 2024). Because the load forecast in the NYCA continues to increase for the years 2015 – 2024, the LOLE for each of the external areas can experience increases despite the freeze of external loads and capacity.

The topology used in the MARS model is represented in Figures D-1 and D-2 for the year 2015, and Figures D-3 and D-4 for the year 2016. The internal transfer limits modeled are the summer emergency ratings derived from the RNA Power Flow cases discussed above. The external transfer limits are developed from the NPCC CP-8 Summer Assessment MARS database with changes based upon the RNA base case assumptions.

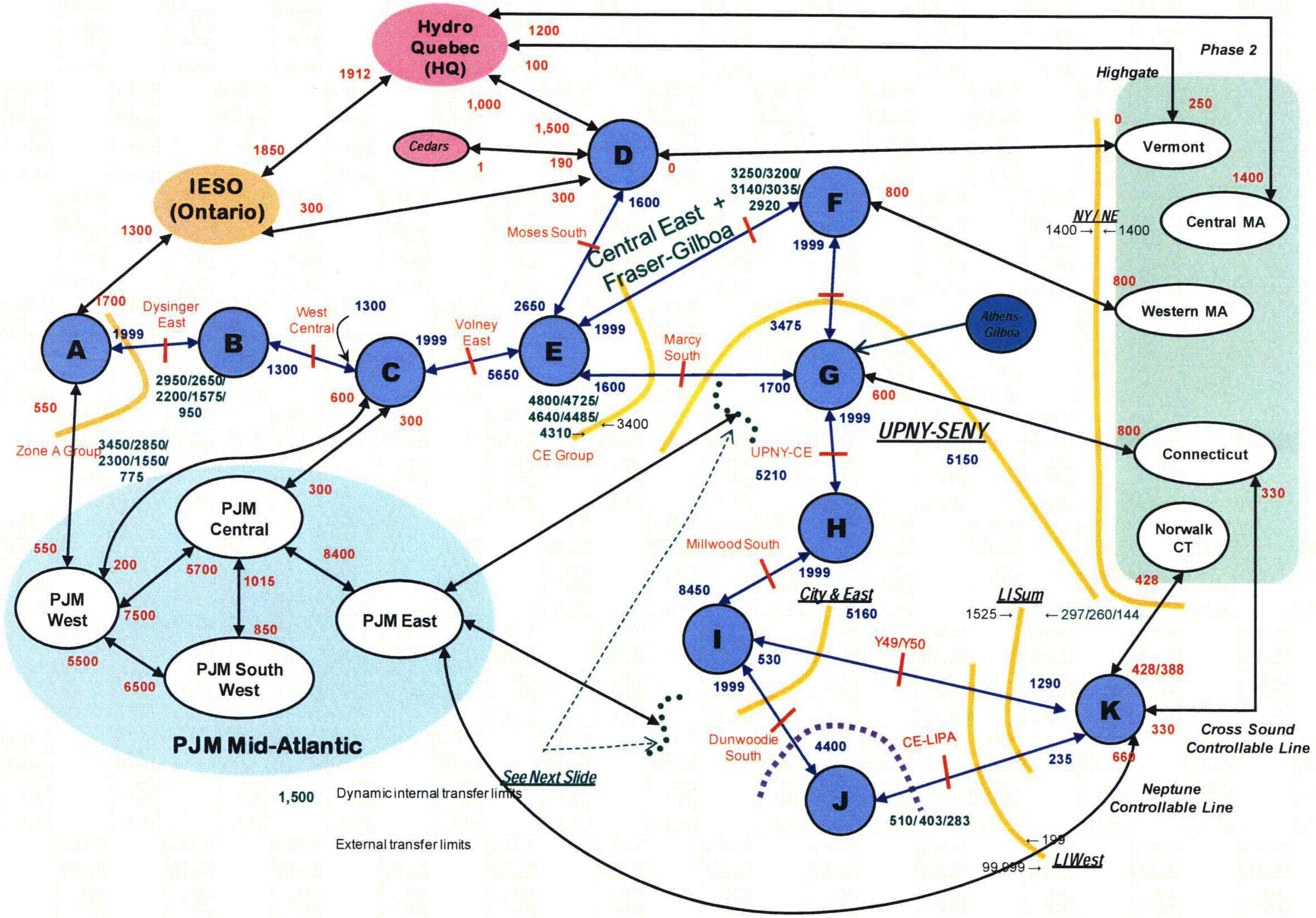
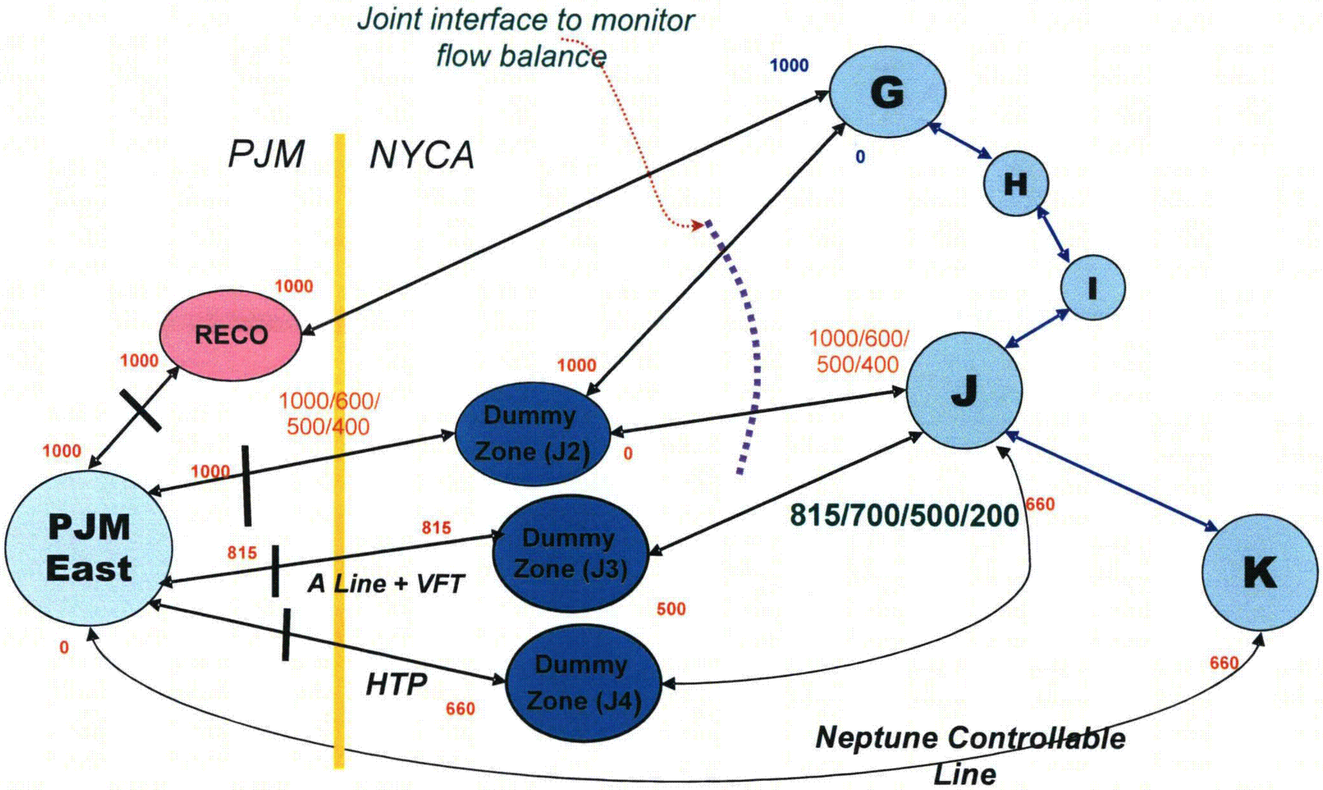


Figure D-1: MARS Topology for Year 2015



(PJM East to RECO) +(PJM East to J2) + (PJM East to J3) + (PJM East to J4) = 3075 MW

Figure D-2: PJM-SENY MARS Topology for Year 2015

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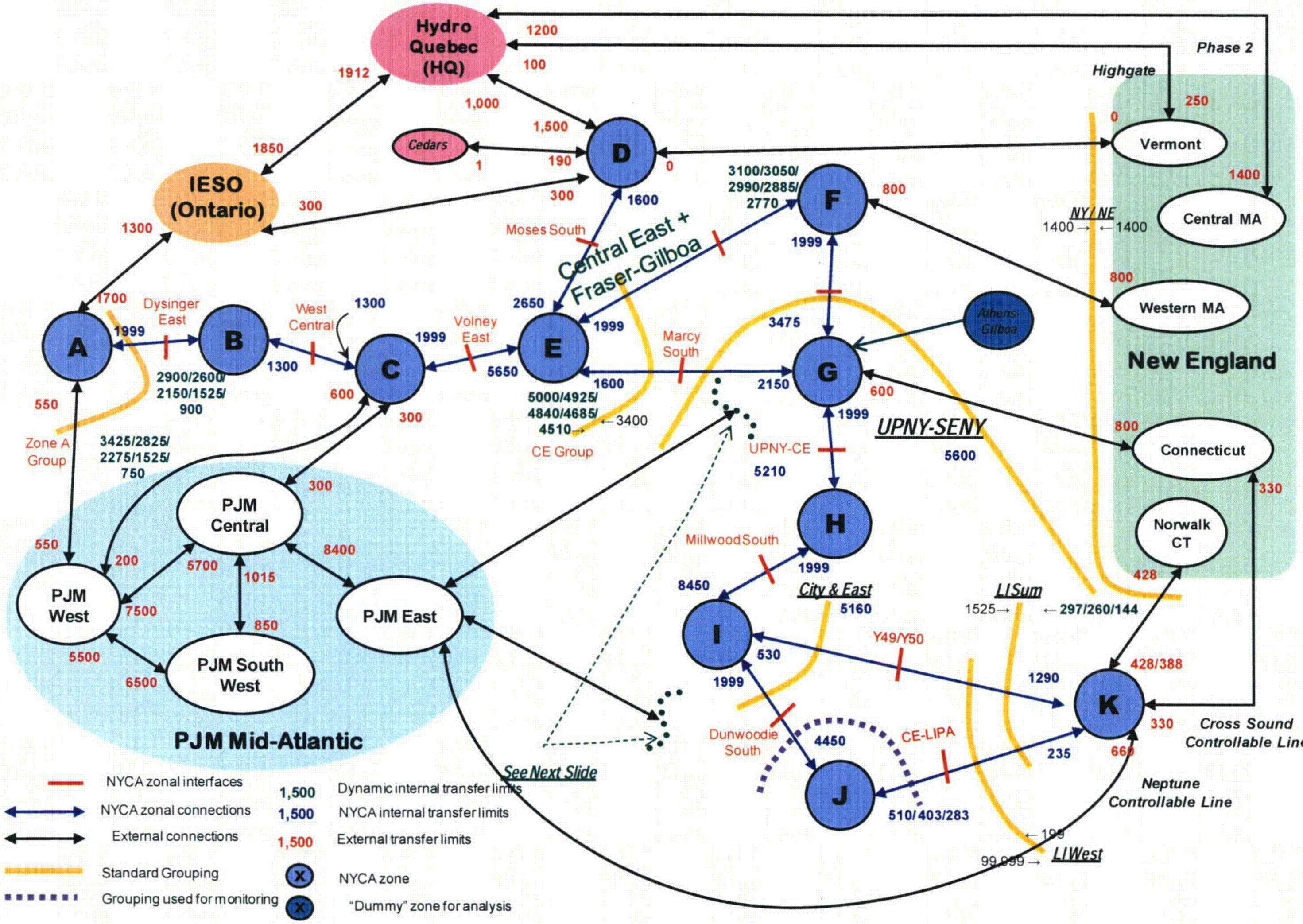
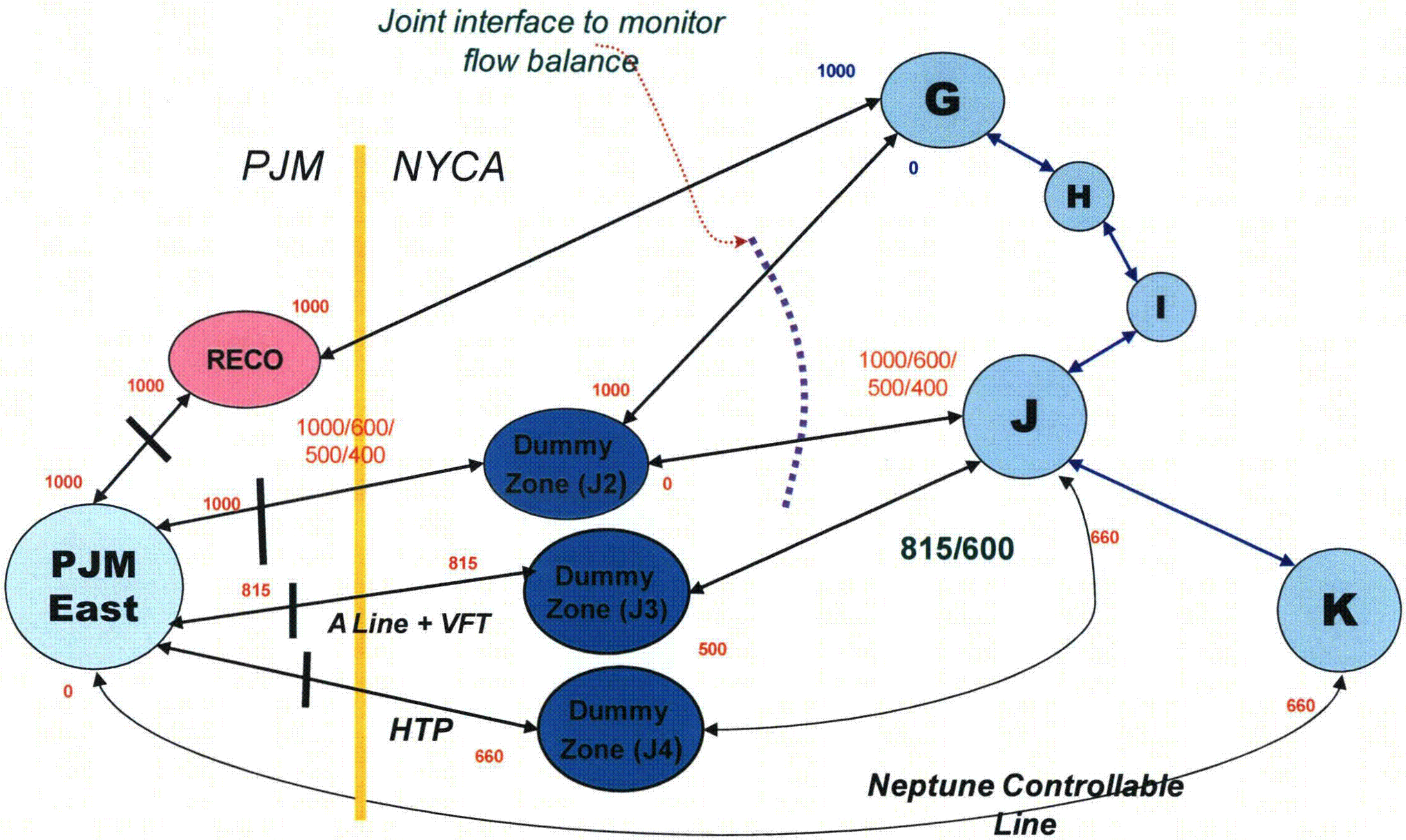


Figure D-3: MARS Topology for Year 2016



(PJM East to RECO) + (PJM East to J2) + (PJM East to J3) + (PJM East to J4) = 3075 MW

Figure D-4: PJM-SENY MARS Topology for Year 2016

D-4 Short Circuit Assessment

Table D-2 provides the results of NYISO's short circuit screening test. Individual breaker assessment (IBA) is required for any breakers whose rating is exceeded by the maximum fault current. Either NYISO or the Transmission Owner may complete the IBA.

Table D-2: 2014 RNA Fault Current Analysis Summary Table

Substation Name	Nominal kV	Lowest Rated Circuit Breaker	TO number	2014 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
Academy	345	63	2	32.6	N	N
Adirondack	230	25	5	9.6	N	N
AES Somerset	345	32	4	17.9	N	N
Alps	345	40	5	17.5	N	N
Astoria East	138	63	2	52.2	N	N
Astoria West	138	45	2	46.6	Y	N
Astoria Annex	345	63	2	47.4	N	N
Athens	345	50.2	5	33.9	N	N
Barrett	138	57.8	3	49.3	N	N
Bowline 2	345	40	6	27.6	N	N
Bowline 1	345	40	6	27.8	N	N
Brookhaven	138	37	3	27.1	N	N
Buchanan N.	345	63	2	29.7	N	N
Buchanan S.	345	40	2	39	N	N
Buchanan	138	40	2	15.9	N	N
Stony Creek	230	40	4	9.5	N	N
Canandaiagua	230	40	4	6.5	N	N
Chases Lake	230	40	5	9.1	N	N
Clarks Corners	345	40	4	11.7	N	N
Clay	115	46.7	5	36	N	N
Clay	345	49	5	32.8	N	N
Coopers Corners	345	32	4	17.2	N	N
Corona	138	63	2	52.5	N	N
Dewitt	345	40	5	18.9	N	N
Duley	230	40	7	7.4	N	N
Dunwoodie No.	138	40	2	34.5	N	N
Dunwoodie So.	138	40	2	30.7	N	N
Dunkirk	230	29	5	9.9	N	N
Dunwoodie	345	63	2	50.6	N	N
East 13th	138	63	2	48	N	N
East 179th	138	63	2	48.6	N	N

Substation Name	Nominal kV	Lowest Rated Circuit Breaker	TO number	2014 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
East 75 ST	138	63	2	9.1	N	N
East Fishkill	345	50	2	38.9	N	N
E River	69	50	2	50	Y	N
Eastview	138	63	2	36.9	N	N
Edic	345	41.6	5	32.7	N	N
East Garden City	345	63	7	25.4	N	N
East Garden City	138	80	3	70.5	N	N
Elbridge	345	40	5	16	N	N
ELWOOD 1	138	56.6	3	38.5	N	N
ELWOOD 2	138	56.6	3	38.2	N	N
Farragut	345	63	2	61.8	N	N
Fitzpatrick	345	37	7	41.4	Y	N
Fox Hills	138	40	2	33.7	N	N
Fresh Kills	345	63	2	36.1	N	N
Fresh Kills	138	40	2	27.1	N	N
Fraser	345	29.6	4	19.2	N	N
Freeport	138	63	3	35.9	N	N
Gardenville	230	31.2	5	21.6	N	N
Gilboa	345	40	7	25	N	N
Goethals	345	63	2	29.5	N	N
Gowanus	345	63	2	28.3	N	N
Greenlawn	138	63	3	29.2	N	N
Greenwood	138	63	2	49.8	N	N
Haupague	138	63	3	22.5	N	N
Hellgate	138	63	2	42.8	N	N
High Sheldon	230	40	4	10.5	N	N
Hillside	230	28.6	4	13.2	N	N
Holbrook	138	52.2	3	49	N	N
Holtsgt	138	63	3	45.4	N	N
Hudson E	138	63	2	39.4	N	N
Huntley	230	30.5	5	26.6	N	N
Hurley Avenue	345	30.4	9	17.1	N	N
Independence	345	44.5	5	38.4	N	N
Jamaica	138	63	2	49.2	N	N
Ladentown	345	63	6	40.4	N	N
Lafayette	345	40	5	17.8	N	N
Leeds	345	37.7	5	34.5	N	N
Lake Success	138	57.8	3	38.7	N	N
Marcy	345	63	7	31.9	N	N
Marcy	765	63	7	9.8	N	N

Substation Name	Nominal kV	Lowest Rated Circuit Breaker	TO number	2014 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
Massena	765	63	7	7.9	N	N
Meyer	230	28.6	4	7.1	N	N
Middletown Tap	345	63	7	18.6	N	N
Millwood	138	40	2	19.4	N	N
Millwood	345	63	2	44.8	N	N
Mott Haven	345	63	2	51.3	N	N
Newbridge Road	138	80	3	69.4	N	N
Newbridge Road	345	40	3	8.6	N	N
Niagara	345	63	7	33.8	N	N
Niagara E	230	63	7	56.8	N	N
Niagara W	230	63	7	56.8	N	N
Nine Mile Point 1	345	50	5	43.4	N	N
Northport	138	56.2	3	60.8	Y	N
New Scotland 77B	345	41.5	5	31	N	N
New Scotland 99B	345	32.9	5	31	N	N
Oakdale	345	29.6	4	12.8	N	N
Oakwood	138	57.8	3	28.3	N	N
Oswego	345	44.3	5	32.4	N	N
Packard	230	48.6	5	43.7	N	N
Patnode	230	63	7	9.4	N	N
Pilgrim	138	63	3	60.2	N	N
Pleasant Valley	345	63	2	40.4	N	N
Porter	115	41.1	5	41.3	Y	Y
Porter	230	18.4	5	19.6	Y	Y
Port Jefferson	138	63	3	32.7	N	N
Pleasantville	345	63	2	22	N	N
Queensbridge	138	63	2	44.8	N	N
Rainey	345	63	2	58.4	N	N
Ramapo	345	63	2	45	N	N
Reynolds Road	345	40	5	14.8	N	N
Riverhead	138	63	3	19.1	N	N
Robinson Road	230	34.4	4	14.4	N	N
Rock Tavern	345	57.9	9	31.4	N	N
Roseton	345	63	9	35.4	N	N
Rotterdam 66H	230	39.4	5	13.3	N	N
Rotterdam 77H	230	23.6	5	13.2	N	N
Rotterdam 99H	230	23.4	5	13.3	N	N
Ruland	138	63	3	45.9	N	N
Ryan	230	63	7	10.6	N	N
South Ripley	230	40	5	9.6	N	N

Substation Name	Nominal kV	Lowest Rated Circuit Breaker	TO number	2014 RNA Maximum Bus Fault	IBA Required	Breaker(s) Overdutied
South Mahwah-A	345	40	6	35	N	N
South Mahwah- B	345	40	6	34.7	N	N
Station 80	345	32	8	17.7	N	N
Station 122	345	32	8	16.7	N	N
Springbrook TR N7	138	63	2	26.9	N	N
Springbrook TR S6	138	63	2	29.1	N	N
Scriba	345	55.3	5	46.8	N	N
Sherman Creek	138	63	2	45.5	N	N
Shore Road	345	63	3	27.8	N	N
Shore Road1	138	57.8	3	48.2	N	N
Shoreham1	138	52.2	3	28.2	N	N
Sprain Brook	345	63	2	51.9	N	N
St. Lawrence	230	37	7	33.7	N	N
Stolle Road	345	32	4	14.2	N	N
Stolle Road	230	28.6	4	5.1	N	N
Stoneyridge	230	40	4	7.1	N	N
Syosset	138	38.9	3	34.3	N	N
Tremont1	138	63	2	42.7	N	N
Tremont2	138	63	2	42.6	N	N
Motthaven	138	50	2	13.4	N	N
Vernon East	138	63	2	44.3	N	N
Vernon West	138	63	2	34.9	N	N
Valley Stream	138	63	3	53.7	N	N
Volney	345	45.1	5	36.5	N	N
West 49th Street	345	63	2	52.7	N	N
Wadngrv1	138	56.4	3	26.1	N	N
Watercure	230	26.4	4	13.2	N	N
Watercure	345	29.6	4	9	N	N
Weathersfield	230	40	4	9.1	N	N
Wildwood	138	63	3	28.2	N	N
Willis	230	37	7	12.7	N	N

Tables D-3 provides the results of NYISO's IBA for Fitzpatrick 345kV, Porter 230 kV, Astoria West 138 kV, Porter 115 kV, and Northport 138 kV.

Table D-3: NYISO IBA for 2014 RNA Study

Fitzpatrick 345 kV

Circuit Breaker	Rating	3LG	2LG	1LG	Overduty
10042	37 kA	32.4	34.5	34.1	N

Astoria W. 138 kV

Circuit Breaker	Rating	3LG	2LG	1LG	Overduty
G1N	45	38.9	42.38	44.15	N
G2N	45	38.9	42.38	44.15	N

Northport 138 kV

Circuit Breaker	Rating	3LG	2LG	1LG	Overduty
1310	56.2	52.02	52.5	50.98	N
1320	56.2	52.04	52.08	50.96	N
1450	56.2	49.01	50.83	51.82	N
1460	56.2	26.97	29.38	30.86	N
1470	56.2	31.94	32.43	32.67	N

East River 69 kV

Circuit Breaker	Rating	3LG	2LG	1LG	Overduty
53	50	42.8	44.9	46.1	N
63	50	44.9	44.8	46.1	N
73	50	42.7	44.9	46.1	N
83	50	42.8	45.5	47.1	N
GGT-2	50	39.7	41.6	42.8	N
Gen6	50	39.5	42.2	43.8	N

Porter 115 kV

BREAKER	DUTY_P	DUTY_A	BKR_CAPA	OVERDUTY
R10 LN1	102.1	43911.4	43000	Y
R100 TB3	85.1	36595.3	43000	N
R130 LN13	103	44307.7	43000	Y
R20 LN2	102.1	43910.7	43000	Y
R200 TB4	82.2	35336.9	43000	N
R30 LN3	101.8	43753.4	43000	Y
R40 LN4	101.7	43713.7	43000	Y
R50 LN5	101.7	43732.8	43000	Y
R60 LN6	103.1	44312.4	43000	Y
R70 LN7	101.1	43468.7	43000	Y
R80 LN8	102	43874.6	43000	Y
R8105 BUSTIE	87.7	41846.5	47714.9	N
R90 LN9	103.1	44317.5	43000	Y

Porter 230 kV

BREAKER	DUTY_P	DUTY_A	BKR_CAPA	OVERDUTY
R110 B-11	109.1	26023.6	23857.4	Y
R120 B-12	109.1	26023.6	23857.4	Y
R15 B-TB1	109.1	26023.6	23857.4	Y
R170 B-17	109.1	26023.6	23857.4	Y
R25 B-TB2	109.1	26023.6	23857.4	Y
R300 B-30	54.2	21686.3	40000	N
R310 B-31	54.2	21686.3	40000	N
R320 B-30	109.1	26023.6	23857.4	Y
R825 31-TB2	104.2	24870.9	23857.4	Y
R835 12-TB1	105.1	25082.5	23857.4	Y
R845 11-17	104.1	24825.9	23857.4	Y

D-5 Transmission Security Violations of the 2014 RNA Base Case

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	First Contingency	Second Contingency	2015 Flow (%)	2019 Flow (%)	2024 Flow (%)
A	N.Grid	Packard-Huntley (#77) 230 (Packard-Sawyer)	556	644	704	HUNTLEY - PACKARD 78 230	SB:ROBI230	-	-	100.75
A	N.Grid	Packard-Huntley (#78) 230 (Packard-Sawyer)	556	644	746	HUNTLEY - PACKARD 77 230	SB:ROBI230	-	-	100.73
A	N.Grid	Huntley-Gardenville (#79) 230 (Huntley-Sawyer)	566	654	755	HUNTLEY - GARDENVILL 80 230	SB:ROBI230	-	-	101.54
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	HUNTLEY - GARDENVILL 79 230	SB:ROBI230	-	101.06	102.72
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	ROBINSON - STOLLRD 65 230	HUNTLEY - GARDENVILL 79 230	-	100.47	106.6
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	NIAGARA - ROBINSON 64 345	HUNTLEY - GARDENVILL 79 230	-	-	106.54
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	LEEDS - HURLEY 301 345	HUNTLEY - GARDENVILL 79 230	-	-	103.79
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	ATHENS - PV 91 345	HUNTLEY - GARDENVILL 79 230	-	-	103.33
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	HQ-NY 765	HUNTLEY - GARDENVILL 79 230	-	-	103.32
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	LEEDS - PV 92 345	HUNTLEY - GARDENVILL 79 230	-	-	103.32
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	OS - EL - LFYTE 17 345	HUNTLEY - GARDENVILL 79 230	-	-	102.82
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	NIAGARA - ROBINSON 64 345	T:78&79	-	-	102.79
A	N.Grid	Huntley-Gardenville (#80) 230 (Huntley-Sawyer)	566	654	755	ROBINSON - STOLLRD 65 230	T:78&79	-	-	102.56
B	RGE	Pannell 345/115 1TR	228	282	336	GEN:GINNA	SB:PANN345_1X12282	131.56	-	-
B	RGE	Pannell 345/115 1TR	228	282	336	GEN:GINNA	SB:ROCH_2T8082	103.97	-	-
B	RGE	Pannell 345/115 1TR	228	282	336	GEN:GINNA	PANL 345/115 2TR	103.84	-	-
B	RGE	Pannell 345/115 2TR	228	282	336	GEN:GINNA	SB:PANN345_3T12282	131.56	-	-
B	RGE	Pannell 345/115 2TR	228	282	336	GEN:GINNA	SB:ROCH_2T8082	103.97	-	-
B	RGE	Pannell 345/115 2TR	228	282	336	GEN:GINNA	PANL 345/115 1TR	103.84	-	-
B	RGE	Pannell 345/115 2TR	228	282	336	GEN:GINNA	SB:PANN345_3802	103.54	-	-
B	RGE	Pannell-Quaker (#914) 115	207.1	246.9	284.8	GEN:GINNA	PANL 345/115 3TR	120.41	-	-
B	RGE	Pannell-Quaker (#914) 115	207.1	246.9	284.8	GEN:GINNA	SB:PANN345_1X12282	100.73	-	-
B	RGE	Pannell-Quaker (#914) 115	207.1	246.9	284.8	GEN:GINNA	SB:PANN345_3T12282	100.73	-	-
C	N.Grid	Clay 345/115 1TR	478	637	794	OS - EL - LFYTE 17 345	SB:CLAY345_R130	-	111.53	118.77
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	CLAY - DEW 13 345	SB:OSWE_R985	104.57	-	-
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	OS - EL - LFYTE 17 345	CLAY - DEW 13 345	104.06	-	-
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	CLAY - DEW 13 345	T:17&11	102.89	-	-
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	CLAY - DEW 13 345	B:ELBRIDGE	102.87	-	-
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	CLAY - DEW 13 345	OS - EL - LFYTE 17 345	102.87	-	-
C	N.Grid	Clay-Dewitt (#3) 115 (Clay-Bartell Rd)	116	120	145	OS - EL - LFYTE 17 345	SB:CLAY345_R925	102.71	-	-
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	SB:OSWE_R985	N/A	121.61	135.18	139.48
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	SB:LAFA_ELB	N/A	121.51	133.23	139.79
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	B:ELBRIDGE	N/A	105.72	119.2	122.53
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	OS - EL - LFYTE 17 345	N/A	105.72	119.2	122.53

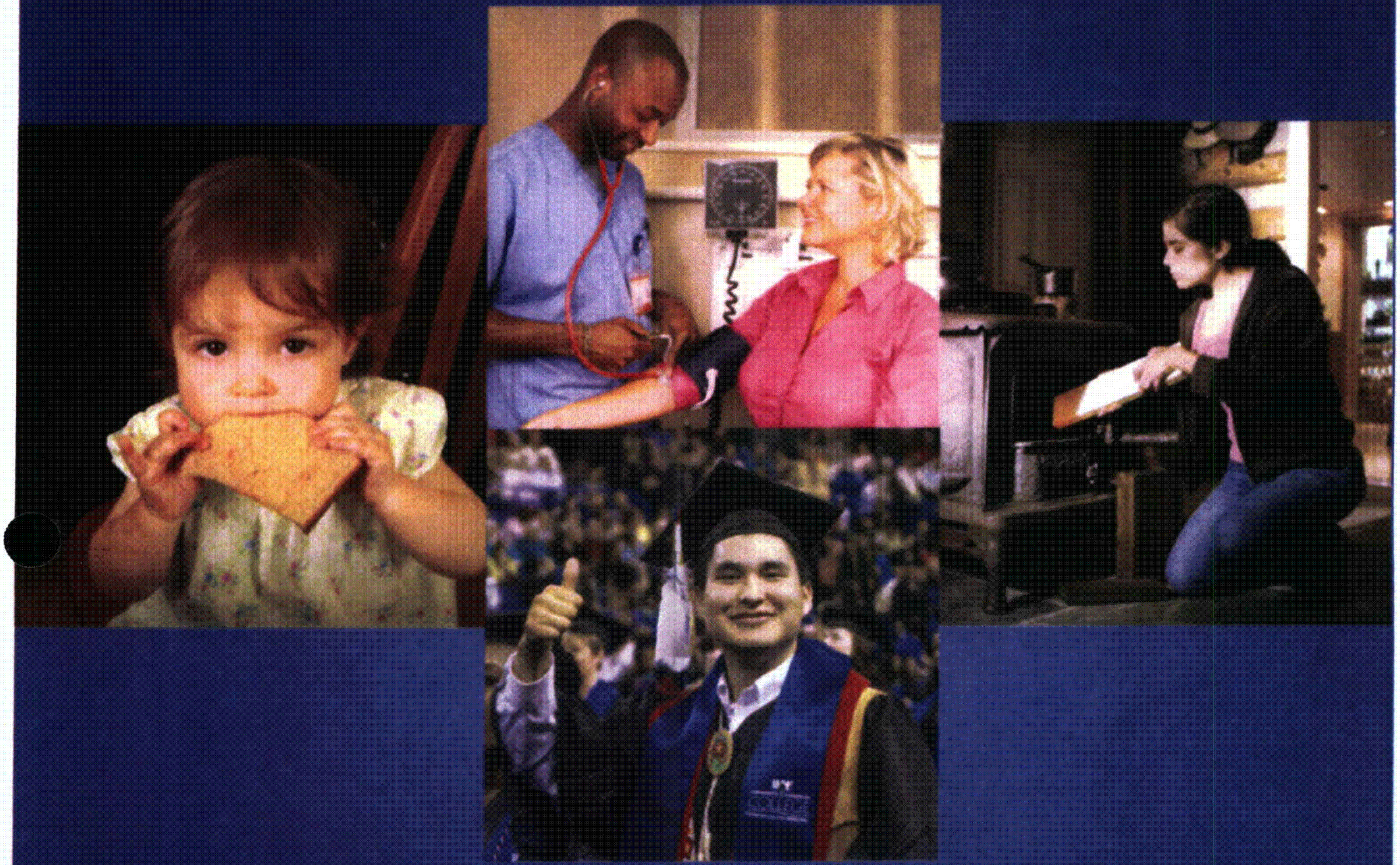
Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	First Contingency	Second Contingency	2015 Flow (%)	2019 Flow (%)	2024 Flow (%)
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	ELBRIDGE 345/115 1TR	N/A	105.3	118.66	121.9
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	T:17&11	N/A	104.98	118.4	121.43
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	ELBRIDGE 345/115 1TR	Base Case	-	119.63	122.96
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	OS - EL - LFYTE 17 345	Base Case	-	119.14	120.84
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	CLAY - WOOD 17 115	SB:LAFA_ELB	137.49	169.93	180.03
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	CLAY - WOOD 17 115	SB:OSWE_R985	136.45	169.38	176.78
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	LFYTE - CLARKCRNS 36A 345	SB:OSWE_R985	127.59	149.95	158.11
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	ELBRIDGE 345/115 1TR	SB:CLAY115_R845	123.88	155.12	159.98
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	OS - EL - LFYTE 17 345	SB:CLAY115_R845	121.84	154.98	157.7
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	CLAY - WOOD 17 115	B:ELBRIDGE	119.37	151.94	157.77
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	CLAY - WOOD 17 115	OS - EL - LFYTE 17 345	119.37	151.94	157.77
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	ELBRIDGE 345/115 1TR	CLAY - WOOD 17 115	118.63	148.2	153.03
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	ELBRIDGE 345/115 1TR	S:CLAY115_WOOD_17	118.63	148.2	153.03
C	N.Grid	Clay-Lockheed Martin (#14) 115	116	120	145	HUNTLEY - GARDENVILL 79 230	SB:OSWE_R985	118.51	142.91	143.55
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	CLAY - TEAL 11 115	SB:DEWI345_R220	109.2	-	-
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	CLAY - TEAL 11 115	SB:DEWI345_R915	109.18	-	-
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	CLAY - TEAL 11 115	SB:DEWI345_R130	109.17	-	-
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	DEWITT 345/115 2TR	SB:CLAY115_R855	107.41	-	-
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	DEWITT 345/115 2TR	CLAY - TEAL 11 115	106.88	-	-
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	DEWITT 345/115 2TR	S:CLAY115_TEAL_11	106.88	-	-
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	CLAY - TEAL 11 115	DEWITT 345/115 2TR	105.34	-	-
C	N.Grid	Clay-Teall (#10) 115 (Clay-Bartell Rd-Pine Grove)	116	120	145	CLAY - DEW 13 345	SB:OSWE_R985	103.87	-	-
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	SB:LAFA_ELB	N/A	-	-	105.15
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	CLAY - LM 14 115	SB:LAFA_ELB	-	119.2	126.66
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	CLAY - LM 14 115	SB:OSWE_R985	-	113.05	118.41
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	GEN:GINNA	SB:LAFA_ELB	-	110.13	111.87
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	NIAGARA - ROBINSON 64 345	SB:LAFA_ELB	-	108.52	108.45
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	EDIC - FRASER 345 SC	SB:LAFA_ELB	-	107.88	112.72
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	ROBINSON - STOLLRD 65 230	SB:LAFA_ELB	-	107.67	107.96
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	HUNTLEY - GARDENVILL 79 230	SB:LAFA_ELB	-	106.9	108.4
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	OS - EL - LFYTE 17 345	SB:CLAY115_R865	-	106.49	108.46
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	PANL - CLAY PC-1 345	SB:LAFA_ELB	-	106.18	112.4
C	N.Grid	Clay-Woodard (#17) 115 (Euclid-Woodward)	174	174	174	PANL - CLAY PC-2 345	SB:LAFA_ELB	-	106.17	112.45
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	CLAY 345/115 1TR	SB:CLAY345_R130	-	109.56	112.9
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	OSW - VOL 12 345	T:17&11	-	-	107.75
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	CLAY 345/115 2TR	SB:CLAY345_R35	-	100.01	103.54
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	CLAY 345/115 1TR	SB:CLAY345_R60	-	-	102.35
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	CLAY 345/115 2TR	SB:CLAY345_R260	-	-	102

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	First Contingency	Second Contingency	2015 Flow (%)	2019 Flow (%)	2024 Flow (%)
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	OS - EL - LFYTE 17 345	SB:CLAY345_R130	-	-	101
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	CLAY 345/115 2TR	SB:CLAY345_R80	-	-	100.96
C	N.Grid	S. Oswego-Clay (#4) 115 (S. Oswego-Whitaker)	104	104	104	CLAY 345/115 1TR	SB:CLAY345_R45	-	-	100.87
C	N.Grid	Oakdale 345/115 2TR	428	556	600	OKDLE 345/115 3TR	Base Case	-	102.85	103.75
C	N.Grid	Oakdale 345/115 2TR	428	556	600	FRASER 345/115 2TR	SB:OAKD345_31-B322	-	103.2	105.42
C	N.Grid	Oakdale 345/115 2TR	428	556	600	WATERCURE 345/230 1TR	SB:OAKD345_B3-3222	102.88	-	-
C	N.Grid	Oakdale 345/115 3TR	428	556	600	OKDLE 345/115 2TR	Base Case	-	-	102.22
E	N.Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)	116	120	145	OS - EL - LFYTE 17 345	SB:CLAY345_R130	-	101.87	104.16
E	N.Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)	116	120	145	CLAY - DEW 13 345	SB:OSWE_R985	-	-	104.73
E	N.Grid	Porter-Oneida (#7) 115 (Porter-W. Utica)	116	120	145	PTR YAHN 115	SB:OSWE_R985	-	101.06	-
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	OS - EL - LFYTE 17 345	SB:CLAY345_R130	106.37	117.17	118.53
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	CLAY - DEW 13 345	SB:OSWE_R985	104.82	115.54	119.01
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	CLAY 345/115 1TR	SB:CLAY345_R130	100.43	113.63	113.46
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	OS - EL - LFYTE 17 345	SB:CLAY345_R925	-	108.25	108.91
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	CLAY 345/115 1TR	SB:OSWE_R985	-	107.77	108.23
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	CLAY 345/115 2TR	SB:OSWE_R985	-	107.53	108.02
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	CLAY - DEW 13 345	B:ELBRIDGE	-	106.13	108.79
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	CLAY - DEW 13 345	OS - EL - LFYTE 17 345	-	106.13	108.79
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	CLAY - DEW 13 345	T:17&11	-	105.85	108.52
F	N.Grid	New Scotland 345/115 1TR	458	570	731	GEN:BETHSTM	Base Case	-	-	106.05
E	N.Grid	Porter-Yahnundasis (#3) 115 (Porter-Kelsey)	116	120	145	PTR TRMNL 115	S:PTR115_SCHLR	-	-	110.12
F	N.Grid	New Scotland 345/115 1TR	458	570	731	GEN:BETHSTM	B:N.S._77	110.56	115.54	146.76
F	N.Grid	New Scotland 345/115 1TR	458	570	731	GEN:BETHSTM	N.SCOT77 345/115 2TR	106	110.45	128.17
F	N.Grid	New Scotland 345/115 1TR	458	570	731	N.SCOT77 345/115 2TR	G:BETHSTM	-	108.85	125.99
F	N.Grid	New Scotland 345/115 1TR	458	570	731	GEN:BETHSTM	S:Reynolds-Rey 345/115	-	-	120.76
F	N.Grid	New Scotland 345/115 1TR	458	570	731	GEN:BETHSTM	S:EMPIRE	-	-	119.66
F	N.Grid	New Scotland 345/115 1TR	458	570	731	N.SCOT99 - LEEDS 94 345	B:N.S._77	-	-	111.99
F	N.Grid	Reynolds 345/115	459	562	755	GEN:BETHSTM	Base Case	107.06	108.49	127.15
F	N.Grid	Reynolds 345/115	459	562	755	EASTOVER - BEARSWMP 230	G:BETHSTM	-	-	126.12
F	N.Grid	Reynolds 345/115	459	562	755	EASTOVER 230/115 1XTR	GEN:BETHSTM	-	-	121.86
F	N.Grid	Reynolds 345/115	459	562	755	GEN:BETHSTM	N.SCOT77 345/115 1TR	-	-	120.57
F	N.Grid	Reynolds 345/115	459	562	755	N.SCOT77 345/115 2TR	GEN:BETHSTM	-	-	117.66
F	N.Grid	Reynolds 345/115	459	562	755	N.SCOT77 345/115 1TR	GEN:BETHSTM	-	-	115.31
F	N.Grid	Reynolds 345/115	459	562	755	LEEDS - HURLEY 301 345	ALPS - REYNOLDS 1 345	-	-	101.44
F	N.Grid	Rotterdam 230/115 7TR	300	355	402	EASTOVER 230/115 1XTR	SB:ROTT_230_R84	123.31	112.59	122.44
F	N.Grid	Rotterdam 230/115 7TR	300	355	402	ROTTERDAM 230/115 1XTR	ROTTERDAM 230/115 3XTR	-	-	116.41
F	N.Grid	Rotterdam 230/115 7TR	300	355	402	ROTTERDAM 230/115 3XTR	ROTTERDAM 230/115 1XTR	-	-	116.32

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	First Contingency	Second Contingency	2015 Flow (%)	2019 Flow (%)	2024 Flow (%)
F-G	N.Grid	Athens-Pleasant Valley (#91) 345	1331	1538	1724	LEEDS - PV 92 345	T:41&33	-	-	102.98
F-G	N.Grid	Athens-Pleasant Valley (#91) 345	1331	1538	1724	LEEDS - PV 92 345	T:34&42	-	-	100.74
F-G	N.Grid	Leeds-Pleasant Valley (#92) 345	1331	1538	1724	ATHENS - PV 91 345	T:41&33	-	-	103.2
F-G	N.Grid	Leeds-Pleasant Valley (#92) 345	1331	1538	1724	ATHENS - PV 91 345	T:34&42	-	-	100.94

Zone	Owner	Monitored Element	Normal Rating (MVA)	LTE Rating (MVA)	STE Rating (MVA)	First Contingency	Second Contingency	2015 Flow (%)	2019 Flow (%)	2024 Flow (%)
F-G	N.Grid	Athens-Pleasant Valley (#91) 345	1331	1538	1724	LEEDS - PV 92 345	T:41&33	-	-	102.98
F-G	N.Grid	Athens-Pleasant Valley (#91) 345	1331	1538	1724	LEEDS - PV 92 345	T:34&42	-	-	100.74
F-G	N.Grid	Leeds-Pleasant Valley (#92) 345	1331	1538	1724	ATHENS - PV 91 345	T:41&33	-	-	103.2
F-G	N.Grid	Leeds-Pleasant Valley (#92) 345	1331	1538	1724	ATHENS - PV 91 345	T:34&42	-	-	100.94

PLENTY AT STAKE:
INDICATORS OF AMERICAN ENERGY INSECURITY



U.S. SENATORS
LISA MURKOWSKI AND TIM SCOTT

113TH CONGRESS

AN *ENERGY 20/20* WHITE PAPER
SEPTEMBER 2014

United States Senate
WASHINGTON, DC 20510

September 18, 2014

Dear Reader:

As colleagues on the Senate Committee on Energy and Natural Resources, it is our privilege to help shape the focus and direction of the United States' energy policies. Through both rigorous analysis and practical experience, we believe energy is good, and that access to affordable energy is essential.

Among affordable energy's many benefits is the ability to heat our homes in winter, cool them in summer, and to accomplish with the flip of a switch tasks that took previous generations hours of back-breaking labor. The modern conveniences associated with affordable energy have enabled Americans to make more effective use of our most valuable commodity – our time. In turn, they have made our daily lives easier, to say nothing of the material comforts they provide and the high standard of living they enable. They have also freed us to pursue a variety of interests, including more formal education and careers.

We have come a long way. But we must also recognize that affordable energy is hardly guaranteed – and hardly universal. The lack of affordable energy disproportionally impacts minorities and the working poor, and many families feel the sting of high energy costs. Far too often, residents from our home states of Alaska and South Carolina stop us on the street or write letters detailing their heartbreaking struggle with rising energy prices.

In Aniak, Alaska, a foster mother shared her bill for five gallons of stove oil. She simply could not afford to heat her home and provide other essentials for her children. Her receipt graphically illustrates her plight and resonates with us, as no parent should be forced to decide between home heating and food for the family.

A woman from McClellanville, South Carolina, recently explained how she diligently takes online surveys to get an extra $25 for groceries - canned food and a small packet of meat - and is still consistently a few hundred dollars short of making rent and paying utilities.

We hear these stories from our home states every day, and even the national press, such as the Los Angeles Times, periodically tells their stories:

> "Holy Jiminy Christmas, what we're going through," said Dora Napoka, 49, the librarian at the village school [in Tuluksak, Alaska]. "It's like we have to choose between six

> gallons of stove oil or six gallons of gas to go out and get the firewood – or does my baby need infant milk? Which one is more important?"

Many of these troubling stories involve the elderly or disabled – those living on fixed incomes who struggle over whether to spend their precious dollars on much-needed, quality of life medicine or increasing utility bills, like a woman from Columbia, South Carolina recently revealed.

These are just a small sampling of the real life, everyday pain that too many in our home states and around the country are experiencing. Most are not looking for a handout, they're asking for a hand up – an opportunity to work hard, prosper, and change their life for the better. Yet even a slight increase in energy prices could be devastating to their future aspirations.

Another tragic story came from Lancaster, South Carolina where a woman agonizes over wanting nothing more than to have a good paying job to help pay the rent and power bills. She has to spend so much on her household utilities that she might soon be unable to keep her vehicle, which will make getting a job that much more difficult.

The Mayor of North Pole, Alaska, highlighted how affordable energy can impact a state's economy in a letter to the editor of the Anchorage Daily News:

> "If our residents can't spend extra money because every month, especially in the winter, they're scrimping just to pay for heating and lighting their homes, then many of our businesses will also be hurting for lack of sales [...] If a store cuts back or goes out of business, then people are out of work, making it even more difficult for them to pay for essential heat and electricity, and that exacerbates the economic downturn!"

These real-life stories and experiences – along with many others not listed here – compelled us to work together to devise a method to measure the extent of this problem. We are pleased to offer in this paper several new tools, the Indicators of Energy Insecurity (IEIs), which can be used to quantify certain effects of rising household energy costs. As we seek to understand the consequences of higher energy costs, the IEIs will enable us to estimate how many families are pushed below the poverty line, how many lose a significant portion of their spendable budget, and how many are forced to spend more than 10 percent of their income on home energy.

It is important to remember that the individuals and families facing these circumstances because of energy costs are more than just numbers on a chart. These are people: our friends, our neighbors, our coworkers, and our fellow citizens. It should be our goal to keep energy affordable, and ensure that they never face the harsh choice between paying for household energy or other basic necessities.

We hope this paper will initiate a new discussion about American energy insecurity and the dangers associated with rising household energy costs. We welcome your engagement on this important issue, and look forward to a renewed effort to ensure that the benefits of affordable energy flow to more – and ultimately all – Americans.

Sincerely,

Lisa Murkowski
United States Senator

Tim Scott
United States Senator

PLENTY AT STAKE:
INDICATORS OF AMERICAN ENERGY INSECURITY

Summary

- A foundational pillar of our American way of life is access to affordable energy. Today nearly all Americans can obtain electricity, home heating and cooling, cooking fuels, refrigeration, potable water, and communications connectivity. The domestic production and availability of natural gas, oil, nuclear power, coal, hydropower, wind, solar, and other renewables provides Americans with energy security, the access to uninterruptable energy sources at an affordable price.
- However, too many Americans suffer from energy insecurity; they cannot afford the energy required to heat or cool their homes or secure other basic needs such as refrigeration. These Americans are still too often faced with harsh choices between paying for energy and paying for food, medical care, and other necessities.
- The Indicators of Energy Insecurity (IEIs) described in this paper are intended to enable policymakers to consider, in quantitative terms, how a specific action will affect Americans living in all 50 states and the District of Columbia, and thus provide a new way to evaluate public policies and other events that impact energy prices. When energy prices rise, the IEIs can be used to quantify:
    - The number of households that experience a significant decrease in spendable budget;
    - The number of households pushed below the poverty line; and
    - The average household energy burden, expressed as a percentage of average gross income.
- The IEIs illuminate a critical goal – affordability – that must be incorporated in our nation's energy policies.
- Some of the critical findings of this initial use of the IEIs on approximately 1.35 million U.S. Census Bureau records are that a 10 percent increase in household energy costs leads to approximately:
    - 840,000 people across the U.S. being pushed into poverty;
    - 7 million additional people across the U.S. spending over 10 percent of their gross household income on home energy; and
    - 65 percent of all families spending additional money on home energy that could be used to buy between one and three weeks' worth of groceries.

  A 10 percent increase in energy costs is certainly possible, as evidenced by a 110 percent increase in electricity prices in Australia in recent years and a 15 percent increase in electricity prices in Germany from early 2011 to early 2013. Additionally, Fairbanks, Alaska, experienced a 66 percent increase in heating oil costs over the past seven years.
- Poorer households are naturally more sensitive to increases in energy costs and are at far greater risk of energy insecurity.

PLENTY AT STAKE:
INDICATORS OF AMERICAN ENERGY INSECURITY

The American quality of life continues to be the envy of nations around the world. While many different factors contribute to it, a foundational pillar is our access to affordable energy. Today nearly all Americans can obtain electricity, home heating and cooling, clean cooking fuels, refrigeration, potable water, and communications connectivity. All of these services in turn rely on basic energy resources such as natural gas, oil, nuclear power, coal, hydropower, wind, solar, and other renewables. The domestic availability and production of those resources provides Americans with energy security, the access to uninterruptable energy sources at an affordable price.[1]

Even in the land of energy plenty, however, too many Americans suffer from energy insecurity; they cannot afford the energy required to heat or cool their homes or secure other basic needs such as refrigeration. These Americans, while not suffering from extreme "energy poverty,"[2] are still too often faced with harsh choices between paying for energy and paying for food, medical care, and other basic needs. Their plight forces us to confront two important questions: What is the social cost of increased energy prices? And, conversely, what is the social benefit of lower energy prices?

This paper addresses those questions and provides three ways of quantifying the impacts of rising energy costs on American households and families. When energy prices rise, the Indicators of Energy Insecurity (IEIs) introduced here can be used to quantify:

1. The number of households that experience a significant decrease in spendable budget;
2. The number of households pushed below the poverty line; and
3. The average household energy burden, expressed as a percentage of average gross income.

[1] International Energy Agency and Energy Security as a Grand Strategy (Report from the Energy Security as a Grand Strategy Workshop, May 7-8, 2012. Editors Pamela J. Sydelko, Sheila R. Ronis, and Leah B. Guzowski. Published by Argonne National Laboratory, May 2013).

[2] Although this paper focuses on American energy insecurity, global energy poverty is a more severe and even more challenging problem. Defined as a lack of access to electricity and clean cooking fuels by the International Energy Agency (http://www.iea.org/topics/energypoverty/), global energy poverty impacts more than one billion people around the world. It is associated with a dramatically lower quality of life than we are fortunate to enjoy in America, as those without reliable access to energy face heightened risks of disease, malnourishment, and premature death. The lack of access to energy also inhibits economic growth. It bears noting, in the context of this paper, that many of the federal policies that are relevant for addressing energy poverty are complementary to those associated with energy insecurity. Increasing domestic production of hydrocarbons, for example, and encouraging energy exports to help other nations can not only help moderate if not push down energy prices at home, but also reduce the U.S. trade deficit and create domestic jobs, all of which ameliorate the challenges of energy insecurity.

The IEIs are intended to enable policymakers to see clearly, in quantitative terms, how a specific action will affect Americans living in all 50 states and the District of Columbia, and thus provide a new way to evaluate public policies and other events that impact energy prices. The IEIs illustrate real-world impacts that rising energy prices have on domestic households, including how many Americans will face energy insecurity or outright poverty. Fundamentally, the IEIs illuminate a critical goal – affordability – that must be incorporated in our nation's energy policies.[3]

Defining Energy Insecurity

A useful definition of energy insecurity comes not from American law, but from Great Britain's *Warm Homes and Energy Conservation Act*. It defines energy insecurity to include both fuel poverty, the inability to pay for the heating or cooling required to maintain a home at a reasonable temperature,[4] and the loss of access to electricity through cessation of service due to non-payment or other factors.

Energy insecurity causes stress for many Americans on a day-to-day basis and negatively impacts increasing portions of the population as energy prices rise. Energy price increases can of course be deliberate, as a result of policies, or unexpected, such as those that resulted from added demand for heating during last winter's "polar vortex" events.[5] Residential electricity prices for the first half of 2014, a period impacted by the "polar vortex," had the highest year-over-year increase since 2009, with overall prices up 3.2 percent and New England's prices up 11.9 percent.[6]

Individuals and families experiencing energy insecurity commonly make sacrifices to reduce their costs, such as:[7]

- Reducing other household spending by making trade-offs, which can include the diminished ability to buy food or to pay for medical care and education;
- Increasing debt, which can include being late on payments to energy suppliers or increased borrowing from other lenders;

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[3] *See, e.g., Energy 20/20: A Vision for America's Energy Future*, Senator Lisa Murkowski, February 4, 2013, http://www.energy.senate.gov/public/index.cfm/documents-republicans.
[4] Warm Homes and Energy Conservation Act, http://www.legislation.gov.uk/ukpga/2000/31/section/1/enacted.
[5] Propane Supply, Energy Information Administration (EIA) Administrator Adam Sieminski, briefing to the U.S. Senate Committee on Energy and Natural Resources, January 28, 2014.
[6] U.S. Energy Information Administration, August 2014 *Electric Power Monthly.*
[7] Wallace, A., A. Wright, and P. Fleming, Fuel poverty and household energy efficiency in England. Institute of Energy and Sustainable Development, De Montfort University, January 2008, and Urge-Vorsatz, D., and S.T. Herrero, Employment, energy security and fuel poverty implications of the large-scale, deep retrofitting of the Hungarian building stock, Presented at IEA Fuel Poverty Workshop: Evaluating the Co-Benefits of Low-Income Weatherisation Programmes, Dublin, Ireland, January 2011.

- Switching fuels to less expensive albeit less convenient and with greater emissions options (*e.g.*, from oil to firewood);
- Maintaining low or high indoor temperatures when heating or cooling, respectively; and
- Closing off rooms or sections of a residence to avoid heating or cooling those areas.

The effects of these sacrifices are heightened odds of food insecurity, more frequent relocations, poorer health, decreased educational achievement, and reduced productivity.[8]

Fairbanks, Alaska, is one example of a community that faces energy insecurity challenges. Located in the interior part of the State, its winter temperatures are extremely cold: the average high temperature in January is just three degrees Fahrenheit, while the lowest winter temperature ever recorded is -66 degrees Fahrenheit (not including wind chill).[9] Clearly, local residents' ability to heat their homes is critical. In recent years, however, the cost of heating oil in Fairbanks has increased dramatically (66 percent between June 2007 and January 2014).[10] As prices have risen, the household energy burden of local residents has increased significantly. To help lower their energy bills, more people have shifted to burning wood for space heating. This has impacted the population in several ways, all of which have had adverse effects on human health.[11]

While Alaska may appear to be a special case, home heating plays a significant role in energy consumed throughout the United States: over 40 percent of total household energy consumption is for space heating. Other household energy spending breaks down at about 35 percent for lighting, appliances, and electronics; 18 percent for water heating; and six percent for air

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[8] Cook, J., Frank, D., 2008, Food security, poverty, and human development in the United States, Annals of the New York Academy of Sciences 1136, 193–209.; Frank, D.A., Heat or Eat: Children's Health Watch, Presented at IEA Fuel Poverty Workshop: Evaluating the Co-Benefits of Low-Income Weatherisation Programmes, Dublin, Ireland, January 2011; Boardman, B., Quality of life benefits (problems) that are hard to measure Presented at IEA Fuel Poverty Workshop: Evaluating the Co-Benefits of Low-Income Weatherisation Programmes, Dublin, Ireland, January 2011; and Home Energy Affordability Gap: 2011, Connecticut Legislative Districts, Prepared for Operation Fuel, Bloomfield, Connecticut, by Colton, R.D. of Fisher, Sheehan & Colton, Belmont, Massachusetts, December 2011.

[9] http://www.weather.com/weather/wxclimatology/monthly/graph/USAK0083.

[10] Calculated from heating oil number one prices obtained from the Alaska Fuel Price Report: Current Community Conditions January 2014, published by the State of Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs and Current Community Conditions: Fuel Prices Across Alaska, June 2007 Update, published by the State of Alaska Department of Commerce, Community, and Economic Development Division of Community Advocacy, Research and Analysis Section.

[11] Switching to firewood also increased the time required to heat homes (wood collection, preparation, etc.), and led to increased wood smoke emissions. These emissions have decreased air quality in the city; EPA has declared the city in non-attainment of the National Ambient Air Quality Standards (NAAQS) for fine particulate matter. NAAQS are intended to protect the health of United States citizens.

conditioning.[12] Given that most Americans use those services every day, if not every hour, household energy costs ultimately represent a sizeable expense.

According to the Energy Information Administration (EIA), the average household "spent $1,945 on heating, cooling, appliances, electronics, and lighting in 2012 [...] 2.7% of household income."[13] Energy costs for people above and below the poverty line are very similar in absolute dollars, but, not unexpectedly, wealthier households spend a smaller percentage of their income on energy than poorer households.[14] Poorer households are naturally more sensitive to increases in energy costs and are at far greater risk of energy insecurity.

Indicators of Energy Insecurity

New ways to quantify Americans who are in or at risk of energy insecurity are needed to assess the impacts of potential increases in home energy costs.[15] Accordingly, the following sections detail three methods for quantifying the effects of energy costs on household budgets, the number of families in poverty, and the average household energy burden. The detailed analysis behind these conclusions can be found in Appendix 1.

Household Budget Cuts

An obvious way to map the available household budget after energy costs is to subtract energy spending from gross income. If energy costs increase, the money required to pay those costs comes out of the budget available for other essential needs. Given the essential nature of energy, the associated price increases often crowd-out or eliminate other household essentials including food, clothing, medical care, and education.

Figures 1 and 2 show the direct impacts of increasing household energy costs on family budgets. (Note that we are illustrating the IEI methodology in these figures for South Carolina, which, along with Alaska, is representative of the nation as a whole.) Figure 1 shows the share of households paying more for energy for various ranges of energy price increases. For example, a 10 percent increase in household energy costs results in over 80 percent of all families spending an additional $100-$500 per year on energy. If energy costs rise 50 percent, nearly 90 percent of

[12] EIA, Today in Energy, March 7, 2013, http://www.eia.gov/todayinenergy/detail.cfm?id=10271. Data from 2009.
[13] EIA, Today in Energy, April 18, 2013, http://www.eia.gov/todayinenergy/detail.cfm?id=10891.
[14] Home Energy Affordability Gap: 2011, Connecticut Legislative Districts, Prepared for Operation Fuel, Bloomfield, Connecticut, by Colton, R.D. of Fisher, Sheehan & Colton, Belmont, Massachusetts, December 2011.
[15] The IEIs do not encompass transportation costs, which consume an additional portion of each household's income. Transportation costs are significant; for example, the Energy Information Administration reported that "Gasoline expenditures in 2012 for the average U.S. household reached $2,912, or just under 4% of income before taxes." (EIA, Today in Energy, February 4, 2013, http://www.eia.gov/todayinenergy/detail.cfm?id=9831). The costs included within the IEIs are those associated with fuels and electricity for heating and cooling, cooking, heating water, lighting, using appliances, and other non-transportation usages.

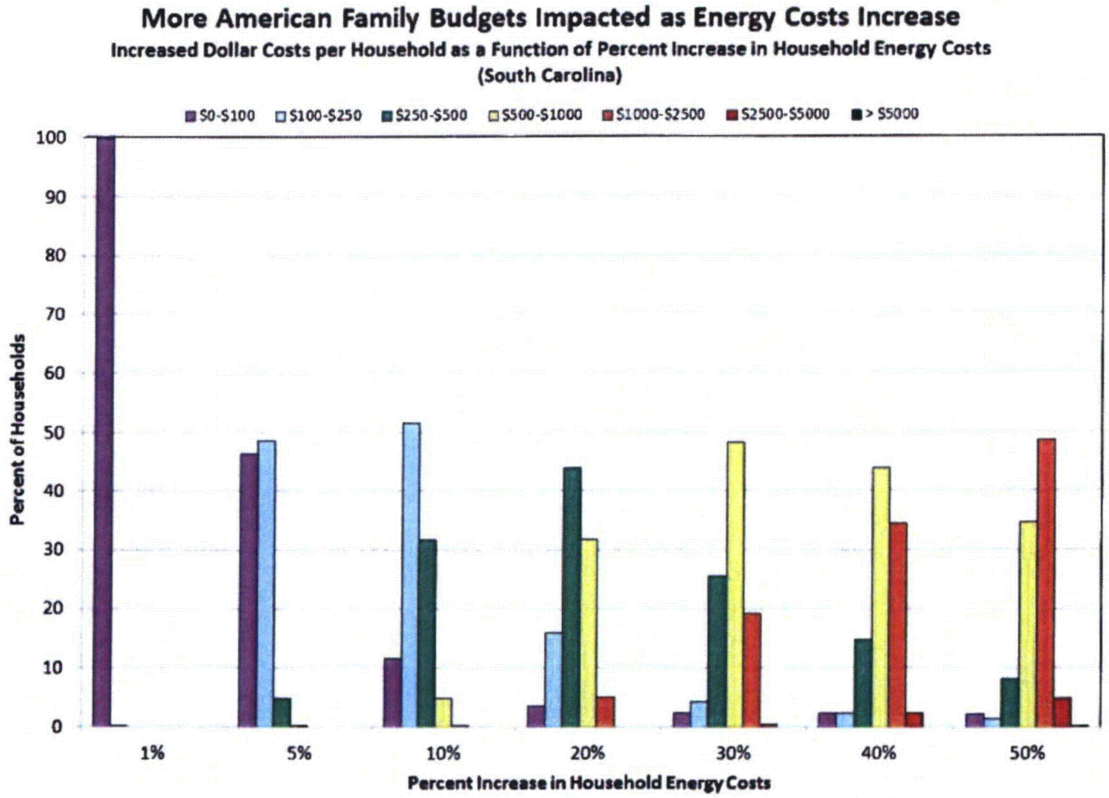

Figure 1. Increase in share of households spending more on the energy budget as a function of increases in energy costs.

households would be spending an additional $500-$2500 per year. It bears noting that a 50 percent increase in energy costs is certainly possible, as evidenced by a 110 percent increase in electricity prices recorded in Australia in recent years.[16] Similarly, Germany and the U.K. saw a 15 and 22 percent increase in electricity prices, respectively, from the first half of 2011 to the first half of 2013.[17]

Figure 2 illustrates the household budget impacts from Figure 1 in terms of the reduction in the average grocery budget for a family of four.[18] Figure 2 shows that a small increase in energy costs can have a dramatic impact on a family's food budget. A 10 percent increase in energy costs equates to an amount equal to what the household would spend on groceries over a one to three week period.

[16] http://www.foxnews.com/world/2013/09/06/australian-voters-angry-over-high-electricity-bills-ready-to-punish-government/.

[17] European Commission, Eurostat, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/File:Half-yearly_electricity_and_gas_prices,_first_half_of_year,_2011%E2%80%9313_%28EUR_per_kWh%29_YB14.png.

[18] Using the U.S. Department of Agriculture thrifty food plan, the tightest budget plan at $149.90 per week. The thrifty plan was chosen because it most represents the budgets of those who have the least to spend.

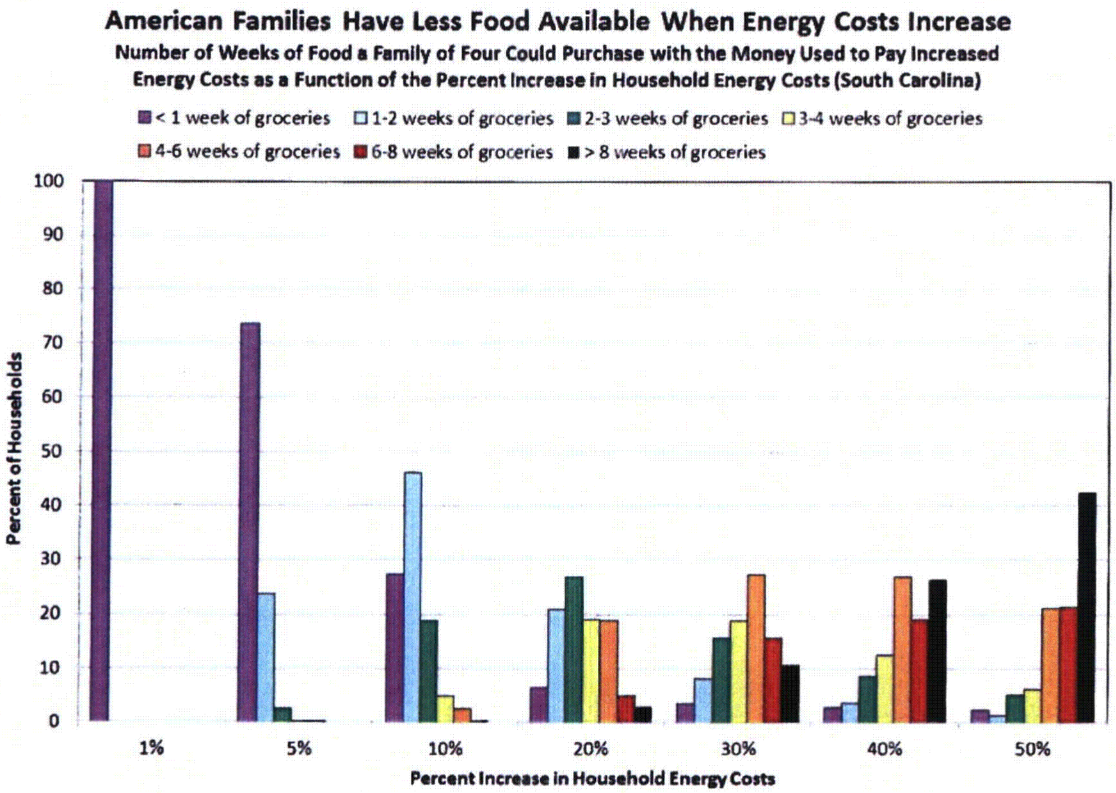

Figure 2. Share of households with specified number of weeks of groceries eliminated by money used to pay higher energy costs. (Grocery budget from USDA thrifty plan, family of four.)

Pushing Households Below The Poverty Line

Another way to look at the impacts of increasing energy costs is to quantify how many families are pushed below the poverty line as household budgets are saddled by additional energy costs.

Figure 3 shows, on a state-by-state basis, the number of individuals falling below the poverty line in the United States when home energy costs are increased by 10 percent. Taken as a whole, more than 300,000 additional households with over 840,000 Americans would be pushed below the poverty line. A 10 percent increase in energy costs was chosen because it is realistic, and could be the result of the enactment of public policies, shifting market conditions, or unexpected events. Higher increases are also possible.

As with the household budget cut described above, Southeastern states are more significantly impacted than the rest of the country.

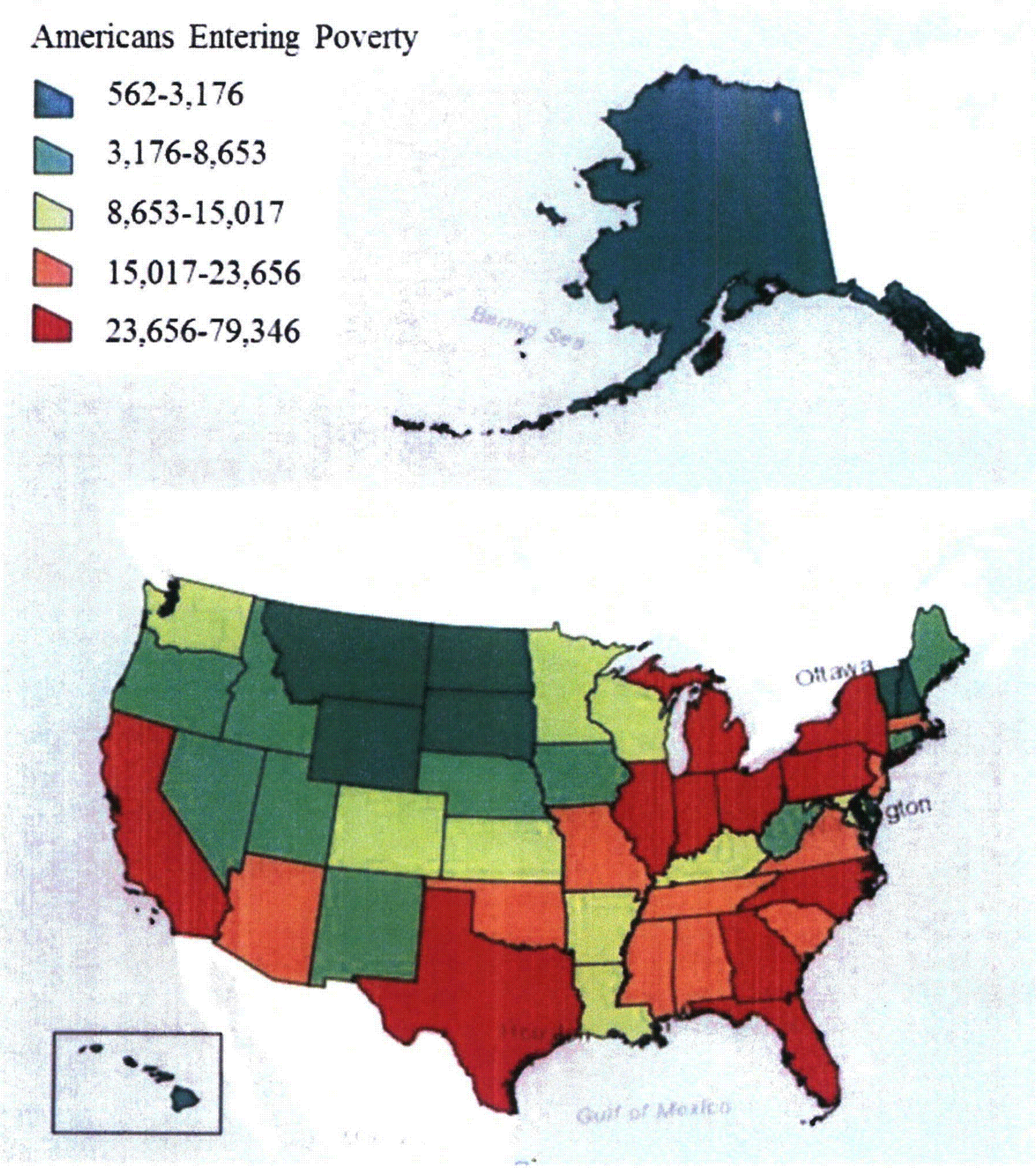

Figure 3. Number of people pushed below the poverty line as home energy costs increase by 10 percent.

Household Energy Burden

The third IEI for illustrating the impacts of energy costs on households is to calculate the increase in a household's energy burden, which can help predict increasing levels of energy insecurity.

Figure 4 shows the average household energy burden in each state as a percentage of total household income.[19] As might be expected, the areas with the highest shares of families in energy insecurity correspond closely with the areas of the highest percentage of families facing a significant budget cut or being forced into poverty due to an increase in home energy costs. These household budgets are already stressed so any additional energy costs resulting from increasing energy prices substantially impacts them.

Importantly, there are a significant number of households in energy insecurity that are not below the poverty line (Figures 5 and 6). This can be seen when the share of households with energy insecurity (*i.e.*, high energy burdens) is divided into two categories based on the poverty line. The first category shows the energy burden only for households below the poverty line (Figure 5); the second shows energy burdens for households above the poverty line (Figure 6).

It is noteworthy that the percentages of households in each category are very similar for most states. The Southern states have higher percentages of households in both poverty and energy insecurity than the rest of the country. The Northeastern states have higher percentages of households in energy insecurity but not in poverty, compared to households in both energy insecurity and poverty. States on the West Coast have lower percentages of households in energy insecurity, both in and not in poverty, than the rest of the country.

Almost three million households or 7 million people will enter energy insecurity across the country if household energy costs increase by 10 percent. For example, the total would be approximately 19,000 and 132,000 households in Alaska and South Carolina, respectively.

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[19] $Household\ Energy\ Burden = \frac{Household\ Energy\ Costs}{Household\ Income} x\ 100$

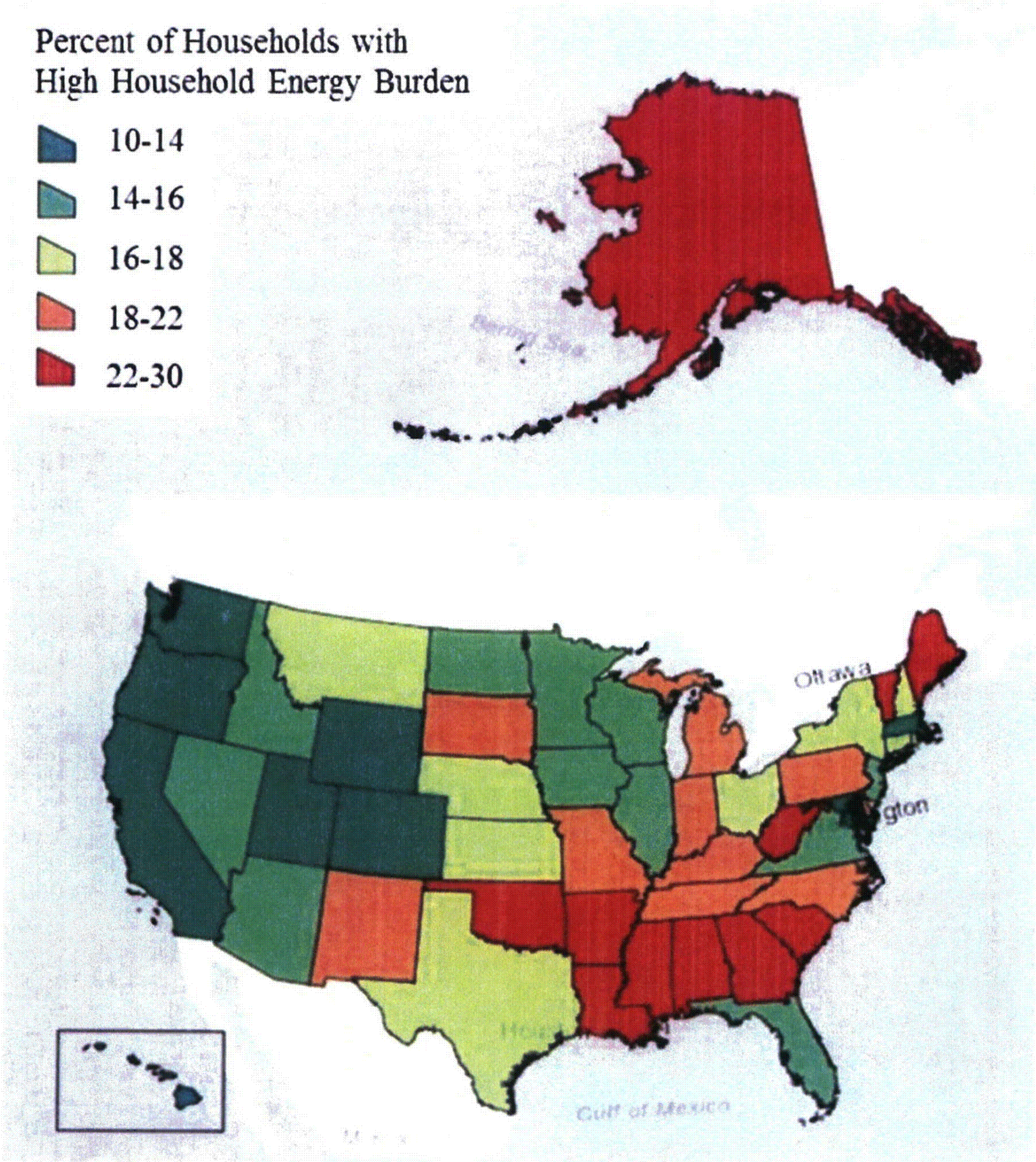

Figure 4. A map showing the spatial distribution of the percentage of households with a high household energy burden (spending more than ten percent of household gross income on home energy) in each state in 2012. The colors represent different quintiles of energy insecurity, with states depicted in red having the highest incidence of energy insecurity.

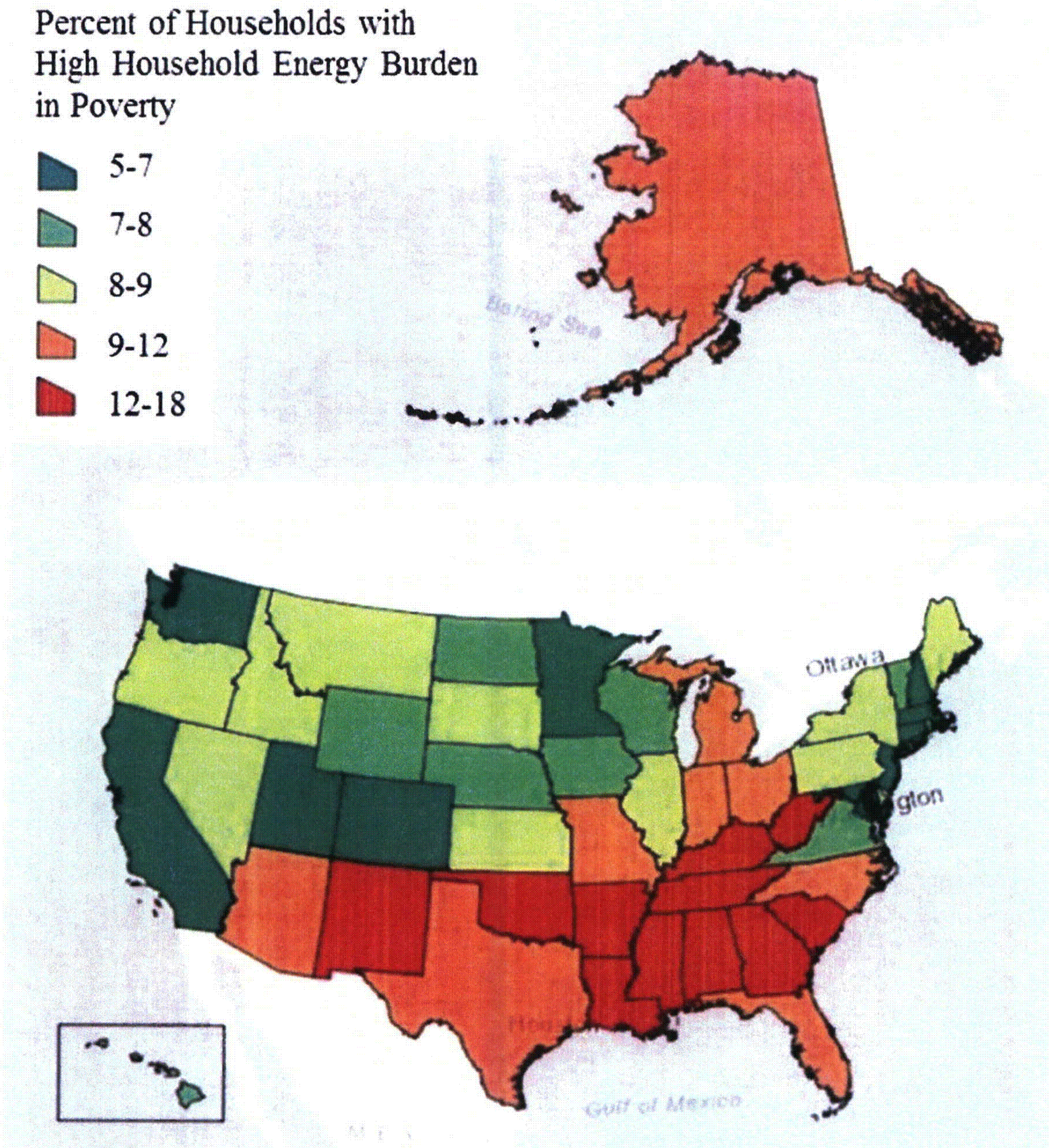

Figure 5. The spatial distribution of households in each state with high household energy burdens and in poverty, expressed as a percentage of total households.

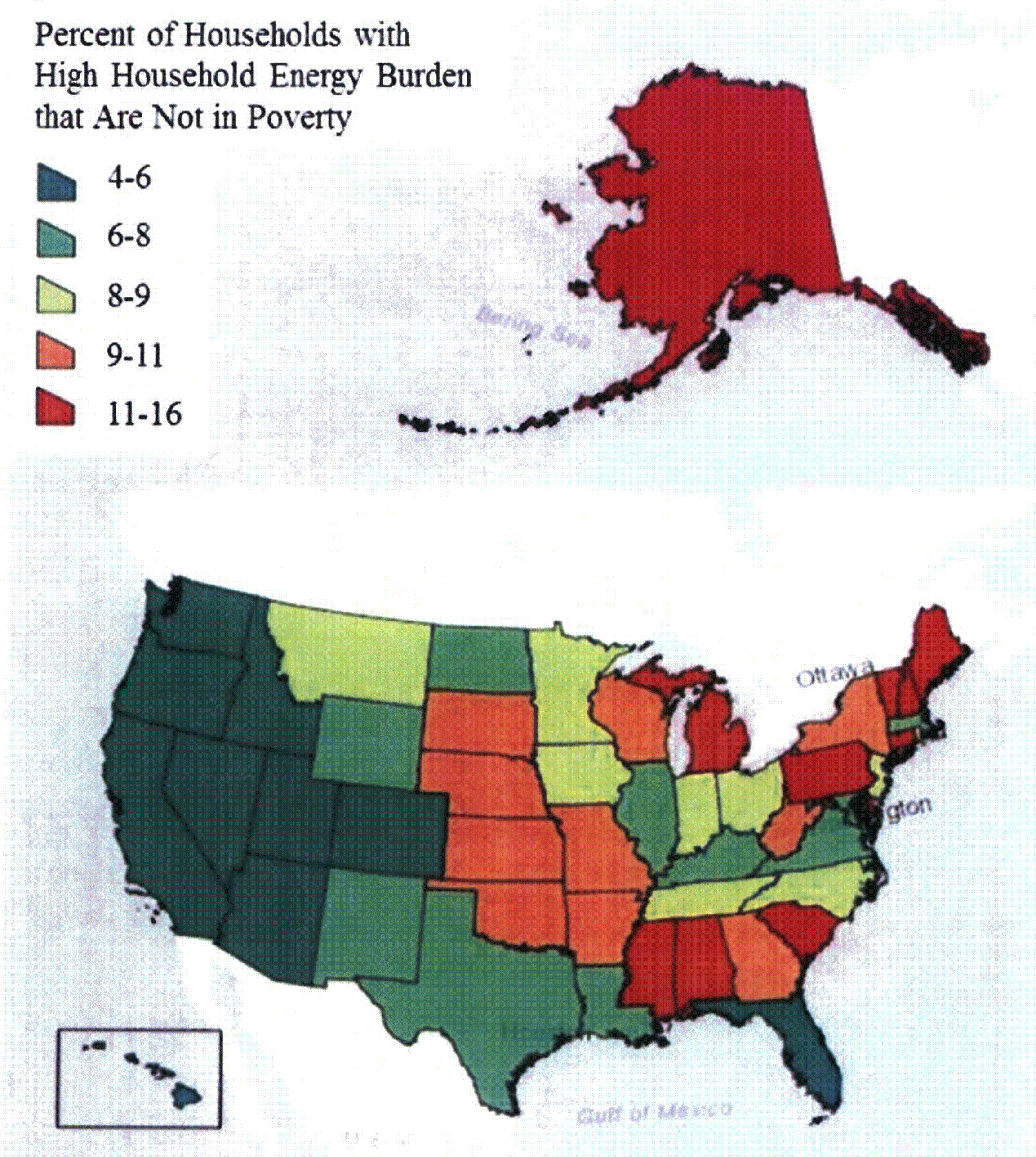

Figure 6. The spatial distribution of households in each state with high household energy burdens that are not in poverty, again expressed as a percentage of total households.

Clearly, rising household income reduces the impact of current or increasing energy costs. As shown in Figures 7 and 8, households with incomes just above the poverty level are most impacted by changes in household energy costs.

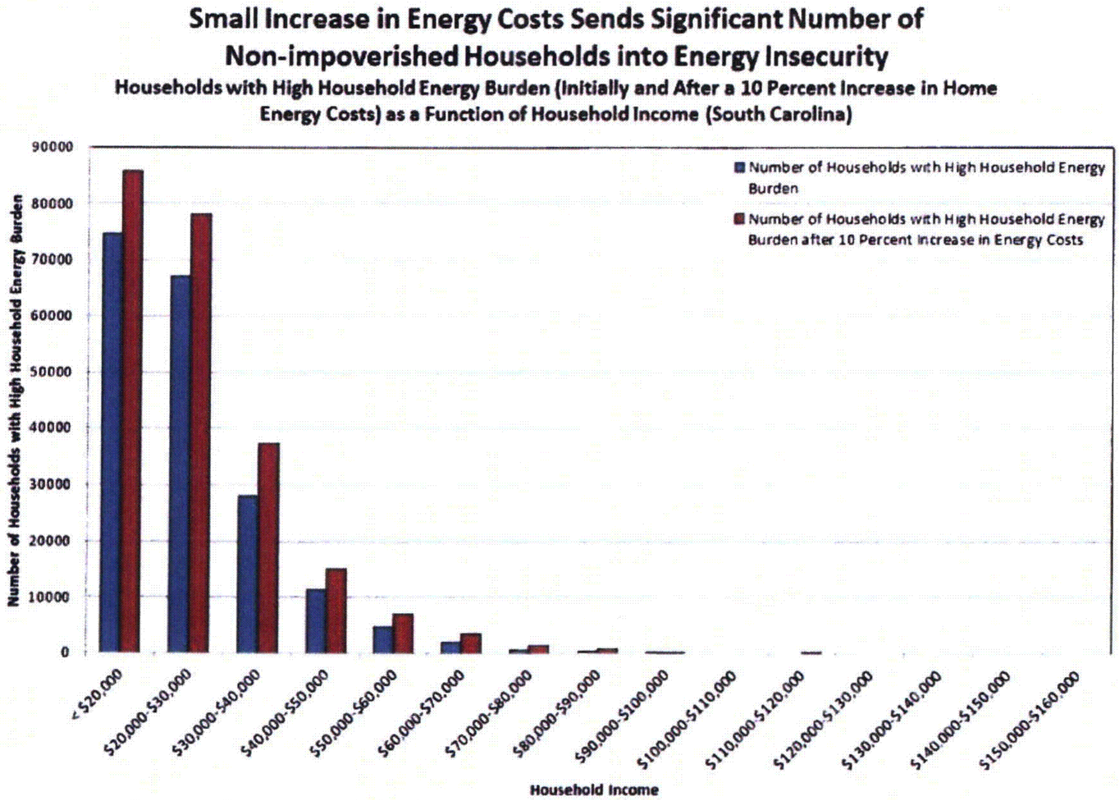

Figure 7. The distribution of households with energy insecurity as measured by high household energy burdens but not in poverty as a function of household income for South Carolina for the original case (blue) and a 10 increase in energy costs (red). South Carolina demonstrates the impact of cooling costs on energy insecurity.

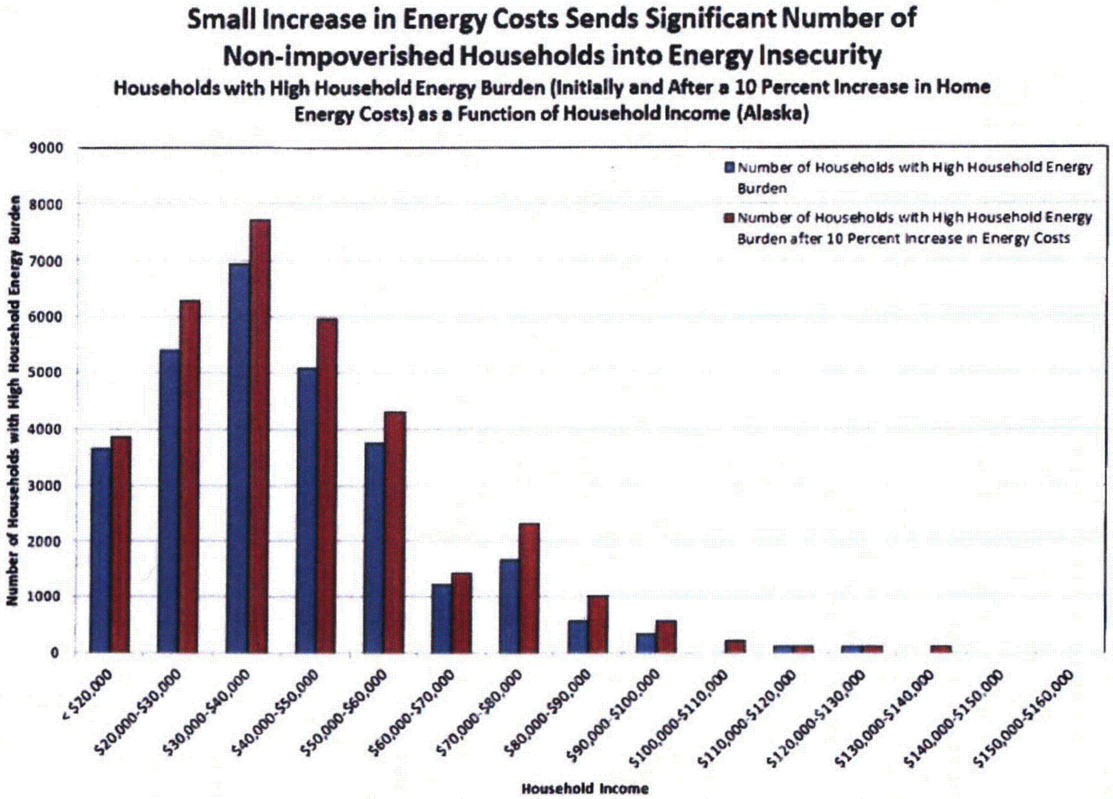

Figure 8. The distribution of households with energy insecurity, as measured by high household energy, but not in poverty as a function of household income for Alaska for the original case (blue) and a 10 increase in energy costs (red). Alaska shows a larger number of households with high household energy burdens, even at higher household income levels. The extreme climate of Alaska may be responsible for this effect; it is expensive to heat a dwelling to a comfortable temperature when the outside temperature can fall to -60 degrees Fahrenheit. The cost of fuels is also higher in Alaska than in most other parts of the country.

The Path Forward

As indicators of energy insecurity, the IEIs described in this paper provide new methods for estimating how increases in energy costs will affect the population of a specific state as well as the country as a whole. The methods introduced here demonstrate that increasing household energy costs have a broad and significant adverse effect on the poor and near-poor members of American society. Any policy proposal that would tend to increase the cost of energy should therefore be fully evaluated for its impact on energy insecurity, in order to give policymakers a complete picture of its potential consequences. Pushing more families into poverty triggers a number of significant socioeconomic issues, including increased government spending and a growing dependence on government social and safety net programs.

There are of course numerous ways to mitigate impacts of energy cost increases. The first approach includes encouraging – or at least not actively disadvantaging – the supply of low-cost sources of electricity and heating fuels, and taking steps to minimize cost increases arising from emerging energy resources. It can also include financial assistance for qualifying households, although given the history of the federal Low Income Home Energy Assistance Program (LIHEAP) program[20] and the federal government's budget challenges, expecting substantially more funding from the federal government to pay higher energy costs for qualifying households is not realistic. Naturally, however, the preferred circumstance is for energy to be affordable and the economy to be strong, enabling citizens to heat and cool their homes without having to depend on federal assistance for such basic needs.

It bears noting that programs to increase energy efficiency and promote conservation can be viable ways to mitigate energy insecurity. However, some caution is needed here given that a program that works in Columbia, South Carolina, may not be effective in Bettles, Alaska, and *vice versa*. And, more relevant to the thesis of this paper, some programs intending to bring down household energy costs do not directly benefit, and in some cases may disadvantage, low-income households. To use Fairbanks, Alaska, as an example, citizens who took advantage of an energy rebate program designed to improve the efficiency of the housing stock were financially secure and could afford the up-front costs associated with the program. Some families interested in the program could not participate in it because they were unable to secure a loan for the up-front energy efficiency improvement costs even though those costs would have been refunded by the program.

The foregoing discussion should prompt a number of key questions at the federal level:

- How best can federal policy help relieve energy insecurity for the American people?
- How can federal policy help decrease (or inhibit increases) in the cost of electricity and other household energy sources?
- How can federal policy help decrease the cost of energy in remote communities?
- What are the barriers to the deployment of less expensive energy sources in Alaska, other sparsely populated states or regions, and other regions, such as the southeast, where the incidence of energy insecurity is high?
- What are the roles and effects of direct federal assistance?

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[20] Spar, K., Federal Benefits and Services for People with Low Income: Programs, Policy, and Spending, FY2008-FY2009, Congressional Research Service Report R41625, January 31, 2011. LIHEAP is administered by the Department of Health and Human Services. The number of households receiving heating assistance in 2009 was approximately 7.4 million (heating or winter crisis assistance) with roughly 900,000 more receiving cooling assistance. This number represents 23.7 percent of federally eligible households.

- Understanding that the current LIHEAP program only serves fewer than 24 percent of households eligible for assistance and has limited money for weatherization, how can people in poverty improve the weatherization of their housing stock? And,
- How can federal policy more effectively help people suffering an unexpected spike in fuel prices due to circumstances beyond their control (*e.g.*, heating costs from the polar vortex that forced people not normally in energy insecurity into that category)?

Federal, state, and local governments, as well as other non-governmental organizations, have many options to help households decrease their energy insecurity. As households move out of energy insecurity, their improved financial situation will allow them to mitigate the adverse consequences associated with it: they can eat better, afford their medication, send their children to school, and purchase more goods and services. For these reasons, it is important to remain vigilant about keeping energy costs low and lowering them where possible. We can and should decrease energy insecurity in the United States so that all Americans can enjoy an even higher quality of life.

Appendix 1: Methodology

Data Set - American Community Survey

The American Community Survey (ACS) is an ongoing, mandatory, statistical survey that samples a small subset of U.S. households each year in every state and the District of Columbia to determine community characteristics and eligibility for federal programs.[21] Among the household characteristics collected by the survey are the number of people in the household, number of children under six, number of people over 65, type of housing unit (rental, single family house, trailer, etc.), and information on rent and mortgages. For this analysis the key variables in the ACS housing data set are: 1) the annual household income including all salaries, wages, tips, social security, welfare payments and public assistance, retirement benefits, survivor or disability pensions, rental incomes, interest, dividends, royalties, and any other sources of income (HINCP), and 2) the amount of money each household spends on energy in the form of electricity (ELEP), gas (GASP), and other fuels (FULP).[22] The households considered in the analysis are living in non-vacant, non-group homes that are either rented or owned by the household, so families living in apartments, duplexes, attached and detached single family homes, mobile homes, trailers, and boats are all included in the analysis. Over 1.35 million records from 2012 that include data from all 50 states and the District of Columbia were used to perform the analyses.

Groceries – United States Department of Agriculture Thrifty Food Plan

The Official USDA Food Plans: Cost of Food at Home at Four Levels, U.S. Average, June 2014 document provides the basis for quantifying how much money a family spends to provide nutritious meals made at home.[23] The Food Plans give four different price levels for a weekly food cost for a family of four (the thrifty plan, the low-cost plan, the moderate-cost plan, and the liberal plan) based on differences in the specific foods and quantities of foods in each plan. Because the people most impacted by the rising cost of energy will be those with the least disposable income, the thrifty plan ($149.90 per week for a family of four of two adults between 19 and 50 years old and two children, one of whom is between 6 and 8 years old and the other of whom is between 9 and 11 years old), the most inexpensive food plan, was selected for the analyses. For the specific foods and quantities of foods in the Thrifty Food Plan, see Thrifty Food Plan, 2006.[24]

[21] https://www.census.gov/acs/www/

[22] ELEP and GASP are given on a per month basis while FULP is given on an annual basis.

[23] http://www.cnpp.usda.gov/sites/default/files/usda_food_plans_cost_of_food/CostofFoodJun2014.pdf

[24] Thrifty Food Plan, 2006, Report CNPP-19 by Andrea Carlson, Mark Lino, WenYen Juan, Kenneth Hanson, and P. Peter Basiotis, of the Center for Nutrition Policy and Promotion (except for Dr. Hanson who is with the Economic Research Service), U.S. Department of Agriculture, April 2007

Poverty – United States Department of Health & Human Services 2014 Poverty Guidelines

The income levels for each state used to determine if a household is in poverty are the poverty guidelines updated periodically by the U.S. Department of Health and Human Services.[25] For 2014, the guidelines are as follows:

2014 POVERTY GUIDELINES FOR THE 48 CONTIGUOUS STATES AND THE DISTRICT OF COLUMBIA

Persons in family/household	Poverty guideline
For families/households with more than 8 persons, add $4,060 for each additional person.	
1	$11,670
2	15,730
3	19,790
4	23,850
5	27,910
6	31,970
7	36,030
8	40,090

2014 POVERTY GUIDELINES FOR ALASKA

Persons in family/household	Poverty guideline
For families/households with more than 8 persons, add $5,080 for each additional person.	
1	$14,580
2	19,660
3	24,740
4	29,820
5	34,900
6	39,980
7	45,060
8	50,140

[25] http://aspe.hhs.gov/poverty/14poverty.cfm

2014 POVERTY GUIDELINES FOR HAWAII

Persons in family/household	Poverty guideline
For families/households with more than 8 persons, add $4,670 for each additional person.	
1	$13,420
2	18,090
3	22,760
4	27,430
5	32,100
6	36,770
7	41,440
8	46,110

While the U. S. Department of Health & Human Services includes energy costs when it establishes poverty guidelines, the poverty thresholds were not developed as an itemized budget with specific dollar amounts for each type of household expenditure category.

Calculations

The following calculations are performed for every data record that meets the non-vacant, non-group home criteria for inclusion in the analyses. For several analyses, the number of households meeting a criterion, such as "driven into poverty," in each data file is determined by applying the formula to each household in the data file and then counting the number of households that meet the criterion. The number of households meeting a criterion can also be divided by the number of total households in the data file to determine the percentage of households meeting that criterion.

Household energy costs for a year = [(ELEP + GASP)*12] + FULP

Increase in energy costs in dollars = Household energy costs x $\frac{\%\ increase\ in\ cost}{100}$

Increase in energy costs in weeks of groceries = $\frac{increase\ in\ energy\ costs\ in\ dollars}{cost\ per\ week\ of\ groceries}$

Household in poverty if HINCP < poverty guideline for number of people in the household

Household with revised income in poverty if (HINCP – increase in energy costs in dollars) < poverty guideline for number of people in the household

Number of households driven into poverty = number of households with revised income in poverty – number of households in poverty

Household Energy Burden = $\frac{Household\ Energy\ Costs}{Household\ Income}\ x\ 100$