January 28, 2020 NYSRC ICS Meeting #228 Report – Ruby Chan
Prepared for the February 7, 2020 EC Meeting

Milestone Schedule

ICS approved the Milestone Schedule (see ICS Attachment A)

ICS requests EC approval of the Milestone Schedule

High Renewable White Paper

ICS participants provided a few edits to the white paper during the meeting. It was recirculated to the ICS participants after the meeting and comments were due back on January 31. No comments were received. The white paper is attached (see ICS Attachment B).

White Paper Scopes

1. Fix Study Year issue (see ICS Attachment C)

   Expected completion date - May 2020

2. Resource Adequacy with Substantial Quantities of Non-Dispatchable Resources

   A scope for the impacts of a high penetration of intermittent resources is awaiting the finalization of the paper titled *The Impacts of High Intermittent Renewable Resources* and direction from the EC on which recommendations or actions to pursue.

   Expected completion date - 2021

3. External Area Modeling

   The purpose of this white paper is to build upon last year's External Area Modeling white paper which recommended:

   - A review of alternative External Area models which potentially could result in more simplified representations

   - The practice of not modeling EOPs in Externals Areas be revisited.

   Any proposed model changes resulting from this white paper would not be implemented until the 2022 IRM study.

   Expected completion date – 2021

4. Modeling correlation of on-shore wind, solar, off-shore wind, run-of-river and landfill (see ICS Attachment D)

   Expected completion date - 2021

5. Load Forecast Uncertainty

   NYSRC Consultants suggested an historic review of load forecast uncertainty data. The purposes of the review are to:

   - Examine the performance of the LFU model and its impacts on IRM over the past twenty years.
   - Review the load temperature relationships experienced for the existing load level bins and compare to model prediction.
   - Provide a presentation to the ICS showing the above results along with some recommendations, if any, on potential modeling improvements.

   Expected completion date - May 2020

ICS requests EC approval of all the white paper scopes described above.

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2021-22 IRM STUDY MILESTONE SCHEDULE

Month	ICS Meeting	EC Meeting	2021-21 IRM Study Milestones
	Assignments for month		
January	1/3/20	1/10/20	-ICS Identifies issues needing to be addressed for preparation for 2021 IRM Study: milestone schedule; potential new models, including modeling development scope requirements; list of tasks, and initial look at possible Policy 5 revisions.
February	1/28/20	2/7/20	-ICS **approves** milestone schedule. -ICS **approves** list of tasks needed for preparation of 2021 IRM study. -ICS **approves** scopes of potential new models, e.g., external Area modeling. -ICS reviews initial 2021 IRM Study Assumptions Matrix. -EC **approves** milestone schedule.
	ICS/NYISO		-ICS begins preparation of potential new models. -NYISO begins preparation of preliminary transmission topology and requests TO's input.
March	3/4/20	3/13/20	-ICS reviews status of potential new models and updated 2021 IRM Study Assumptions Matrix.
	ICS/NYISO		-ICS completes new model development and prepares white paper.
April	4/1/20	4/9/20	-ICS reviews draft white papers for new models. -ICS reviews updated 2021 IRM Study Assumptions Matrix.
	ICS/NYISO		-NYISO reviews GADS data. -NYISO installs any updated MARS software and benchmarks as necessary. -NYISO begins base case build-up used for parametric analysis.
May	4/28/20	5/8/20	-ICS **approves** new model white papers. -ICS reviews updated 2021 IRM Study Assumptions Matrix. -If applicable, ICS **approves** use of new MARS version. -EC **approves** new model white papers.
	ICS/NYISO		-NYISO verifies preliminary transmission topology with TOs and sends to TPAS and ICS for review.
June	6/3/20	6/12/20	- ICS reviews updated 2021 IRM Study Assumptions Matrix, including preliminary transmission topology. - ICS completes draft of any Policy 5 revisions for EC approval.
July	6/23/20	7/10/20	-ICS **approves** preliminary 2021 IRM Study Assumptions Matrix. -EC **approves** preliminary 2021 IRM Study Assumptions Matrix.
	ICS/NYISO		-NYISO performs parametric study to be used as the basis for Table 6-1 of IRM Study report. -NYISO conducts preliminary IRM tan 45 study following parametric study. -ICS members prepare list of proposed sensitivity cases and submits to ICS chair.
August	8/2/20	8/14/20	-ICS **approves** list of sensitivity cases. -EC **approves** list of sensitivity cases.
	8/17/20*	----	-ICS reviews parametric study results and preliminary tan 45 analysis and IRM.

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	ICS/NYISO		-NYISO sends the completed initial master input file to GE by 8/21.
September	9/2/20	9/11/20	-ICS **approves** parametric results for Table 6-1. -ICS **approves** preliminary 2021 base case IRM. -EC reviews preliminary base case IRM and parametric results.
	ICS/NYISO		-NYISO provides initial masked/encrypted input data to TOs for data quality assurance review by 9/16. -NYISO begins sensitivity testing for Table 7-1 based on preliminary base case. -NYISO staff/LFWG prepares fall load forecast and delivers to ICS. -NYISO, GE and TOs complete preliminary base case data quality assurance reviews. -By 9/25, NYISO submits final transmission topology changes, if any, to TPAS and ICS.
October	9/29/20	10/8/20	-ICS **approves** fall load forecast. -NYISO and TOs report preliminary data base quality assurance review. -ICS accepts preliminary data base quality assurance review. -ICS reviews and approves preliminary sensitivity results. -EC reviews preliminary sensitivity results. -ICS **approves** Final 2021 IRM Base Case Assumption Matrix. -EC **approves** Final 2021 IRM Base Case Assumption Matrix.
	ICS/NYISO		-NYISO completes sensitivity testing. -ICS conducts base case study and determines final base case including tan 45 analysis and IRM. -ICS prepares initial draft IRM report, including Tables 6-1 and 7-1. -NYISO delivers final base case input files to GE for incremental review and masking. -GE provides masked data base to the NYISO.
November	11/4/20	11/13/20	-NYISO provides masked database for final TO review. -NYISO reports any changes based on final base case review. -ICS reviews and provides comments on first draft IRM report. -EC reviews and provides comments on second draft IRM report. -ICS **approves** final 2021 IRM base case. -EC **approves** final 2021 IRM base case. -ICS identifies the need for a Special Sensitivity Case.
	11/18/20*		-ICS accepts final base case quality assurance review. -NYISO completes special sensitivity case Tan 45 analysis. -ICS determines if Special Sensitivity Case should become final base case, and obtains EC approval.
	ICS/NYISO		-ICS prepares final draft IRM report (ICS).
December	11/30/20	12/4/20	-ICS **approves** final draft 2021 IRM report. -EC **approves** 2021 IRM report, Final 2021 IRM, and IRM resolution.
	ICS/EC/NYISO		-Issue 2021 IRM letter to NYISO CEO (EC). -IRM Filing to FERC if required (EC). -Prepare LCR realignment study if Final 2021 IRM is less than base case IRM (NYISO). -Special conference call around 12/13/20, if needed, to approve LCR realignment study (ICS)*.

* Conference call – date shown is preliminary

The Impacts of High Intermittent Renewable Resources

On the Installed Reserve Margin for New York

New York State Reliability Council
Installed Capacity Subcommittee
Draft, January 29, 2020

Table of Contents

Executive Summary 3

Introduction 4

Study Overview 5

Methodology 5

Location 5

Data Preparation 7

Performance Data and Unforced Capacity Ratings 8

Results 11

Conclusions 14

Recommendations 15

Appendix – Additional Thoughts on Future Actions 16

Executive Summary

New York State has clean energy initiatives that will result in thousands of megawatts ("MW") of additions of Front of the Meter photovoltaic ("FTM PV"), onshore wind, and offshore wind generation. The New York State Reliability Council (NYSRC) Executive Committee requested that the Installed Capacity Subcommittee("ICS"), with the support of the New York Independent System Operator, Inc. ("NYISO"), perform an analysis of the potential impact on the Installed Reserve Margin ("IRM") and locational capacity factors[1] from a hypothetical case in which the New York Control Area ("NYCA") has a high immediate penetration of intermittent renewable resources over the period May 2020 through April 2021 (2020 Capability Year). This period was selected because the model had already been developed for setting the 2020 IRM. This analysis calculated the amount of installed generating capacity necessary to operate the New York State electric grid without the probability of the unplanned shedding of load more than one day in ten years[2] under conditions where a large quantity of intermittent (*i.e.,* non-dispatchable) generation is present. This analysis is the first of several that will be needed to fully understand the impacts of increased renewable resource penetration on system reliability.

The study showed that the required NYCA IRM for the 2020 Capability Year would be 42.9% under the high renewable conditions analyzed. This IRM level satisfied the NYSRC and Northeast Power Coordinating Council (NPCC) resource adequacy criterion. The study determined corresponding locational capacity factors of 97.9% and 131.6% for New York City and Long Island, respectively. Together, these results mean that to meet New York's reliability standards, New York will need total installed capacity resources equal to 142.9% of peak load, with additional requirements for resources located in New York City of 97.9% of its peak load and Long Island of 131.6% of its peak load.

The study shows that to meet the resource adequacy criterion, the installed capacity quantity for New York State will need to increase by 24.3 percentage points, from the 118.6% 2020 IRM Study preliminary base case value to 142.9%. The increase in the installed capacity requirement is driven primarily by the intermittent characteristics of weather-dependent resources. The amount of the increase is predominantly a result of the lower availability of intermittent generators, which reduces the average availability of NYCA suppliers. If the introduction of the renewable resources were accompanied by retirement of higher availability traditional dispatchable resources, the average availability of the fleet would further decline, and the IRM and LCRs levels would correspondingly increase.

[1] The term 'locational capacity factors' used here is identified in the IRM Study Report as the 'preliminary LCRs' and is based on the Tan45 methodology. The NYISO establishes final LCRs using other methods.

[2] This design standard is more commonly referred to as the "0.1 days per year Loss of Load Expectation (0.1 LOLE standard)" in technical documents.

In addition, the efficacy of the renewable resources used in this study decreased with increased penetration rates as shown by the drops in UCAP values. The mechanism resulting in this decreased has not yet been determined.

Introduction

New York's electricity industry is transforming rapidly, from traditional, controllable fossil fuel generation to non-emitting, weather-dependent intermittent resources and distributed generation. These changes are driven primarily by State policies and technological advancements. New York State law requires that 70% of load be served from renewable resources by 2030.

Initial assessments of how to reliably serve electricity demand with increased renewables indicate that the primary challenge arises from the variability and intermittency of wind and FTM PV generation. As the penetration of those technologies increases, the grid will likely require more load-following capability, and possibly more fast-response and flexible resources that provide operating reserves to address expected and unexpected changes in net load. The grid will also require a substantial amount of installed reserve capacity that is available to serve load when wind and/or PV generation output is insufficient for periods that may range from hours to several days.

The daily and seasonal variability of eligible intermittent renewable resources compared to conventional resources creates challenges with regard to both the planning and operation of the New York State bulk power system. With the expectation of large-scale integration of renewable resources, the NYSRC is working with the NYISO to ensure that the tools and methods will be available to accurately model renewable resources to measure and maintain grid reliability.

To understand the resource adequacy impacts of increased future renewable facilities, this paper provides the results of a Loss of Load Expectation (LOLE) evaluation to determine the NYCA IRM assuming a hypothetical large-scale increase of onshore wind, offshore wind, and FTM PV generation in New York State. Results of this analysis will help inform the NYSRC in determining the need for new analytical methods, models, and reliability rules. The paper provides the methodology and modeling assumptions used in this evaluation.

It is vital to note that the large-scale integration of renewable resources will not happen independently of other changes to the bulk grid, including necessary transmission enhancements to the bulk and local networks to prevent renewable curtailments. In particular, it is expected that these resources will be complemented by energy storage resources ("ESRs"), such as batteries, as they continue to enter New York's bulk electric system. The NYISO and the NYSRC are exploring the ability of ESRs to offset the intermittent nature of renewable resources. This incremental approach may help inform analytic methods.

Study Overview

The study takes the New York electric system as assumed in the NYSRC 2020 IRM Study Preliminary Base Case ("PBC") and increases renewable capacity by a hypothetical 12,000 MW (4,000 each of FTM PV, onshore wind, and offshore wind). The additional capacity does not displace or replace any existing generators.[3]

Methodology

The NYSRC requested the NYISO to conduct the sensitivity analysis described in this white paper. The NYISO began the evaluation using the 2020 IRM Study preliminary base case (PBC) assumption[4], which satisfy the LOLE criterion that the probability of an unplanned disconnection of firm load due to resource deficiencies is, on average, no more than 0.1 days per year. For the purpose of this sensitivity analysis, an additional 4,000 MW each of onshore wind, offshore wind and FTM PV resources were added to the base case.

Location

The locations of Installed Capacity ("ICAP") placement for both FTM PV and onshore wind units were based on the projections of wind and solar installation represented in the New York State Department of Public Service's Clean Energy Standard Final Supplemental Environmental Impact Statement.[5] These projections were scaled up on a zonal basis to the requisite 4,000 MW for each resource type. The placements of offshore wind capacity were split evenly between Zones J and K. The Zonal ICAP values by resources represented in this sensitivity analysis are provided in Table 1.

[3] Should renewable generation displace existing resources, displaced resources would likely perform better than the system average (*i.e.,* the resources would have lower individual EFORds than the existing NYCA system EFORd). If this is the case, then the IRM calculated in this study under-estimates the IRM level that would be needed to meet the LOLE criterion.

[4] http://nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20222/IRM_2020_Assumption_Matrix_PBC_V2.1_approved[9894].pdf

[5] http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={424F3723-155F-4A75-BF3E-E575E6B0AFDC}

Table 1- ICAP added to PBC Assumptions by Resource Type (MW)

Zone	FTM PV	On-Shore Wind	Off-Shore Wind	Total
A	874	1,030		**1,904**
B				**0**
C	406	994		**1,400**
D		894		**894**
E		1,082		**1,082**
F	1,884			**1,884**
G	448			**448**
H				**0**
I				**0**
J			2,000	**2,000**
K	388		2,000	**2,388**
Total	**4,000**	**4,000**	**4,000**	**12,000**

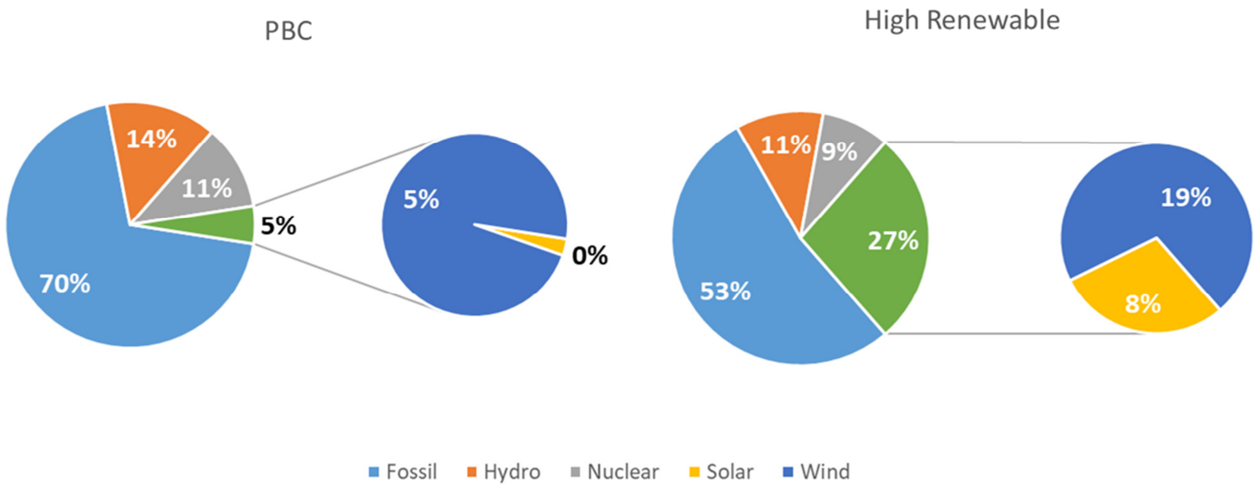
These additions are made to the renewable ICAP present in the 2020 PBC, seen in Table 2. The current system contains minimal FTM PV ICAP resources and no offshore wind resources.

Table 2 - Existing Renewable ICAP in PBC by Resource Type (MW)

Zone	FTM PV	On-Shore Wind	Off-Shore Wind	Total
A		179		**179**
B				**0**
C		513		**513**
D		678		**678**
E		522		**522**
F				**0**
G				**0**
H				**0**
I				**0**
J				**0**
K	57			**57**
Total	**57**	**1,892**	**0**	**1,949**

Figure 1 provides a comparison of the installed capacity mixes by fuel type for both the PBC and High Renewable scenarios.

Figure 1- ICAP Mix Comparison by Fuel



Data Preparation

For study data, the NYISO leveraged a host of sources for each resource. In order to prepare onshore wind data, the NYISO used five years of billing-quality meter data (January 1, 2014 to December 31, 2018), and utilized data from existing wind facilities with Capacity Resource Interconnection Service (CRIS) rights. This data and process is consistent with the PBC methods. The NYISO then scaled up zonal hourly generation profiles to model 4,000 MW of incremental on-shore wind.

For FTM PV data, the NYISO used normalized Congestion and Resource Integration Study (CARIS) 2019 FTM PV profiles, and scaled up the MW by zone. CARIS data was used because there is limited FTM PV wholesale production data, as most PV resources in New York are currently situated behind the meter and reflected in the net load forecast data. These data are based on National Renewable Energy Lab's (NREL) Solar Power Data for Integration Studies[6]. See the NYISO's 2019 CARIS 1 70x30 Scenario Development presentation for more information[7].

Offshore wind generation profiles were compiled by GE using the NREL Wind Toolkit data[7]. The data used in this study were derived from metrics such as meteorological conditions (*i.e.,* wind speed, temperature pressure) and power production modeled at three locations (NY Harbor in Zone J, and LI Shore and LI East End in Zone K), over the period 2007 to 2012. For more

[6] https://www.nrel.gov/grid/solar-power-data.html

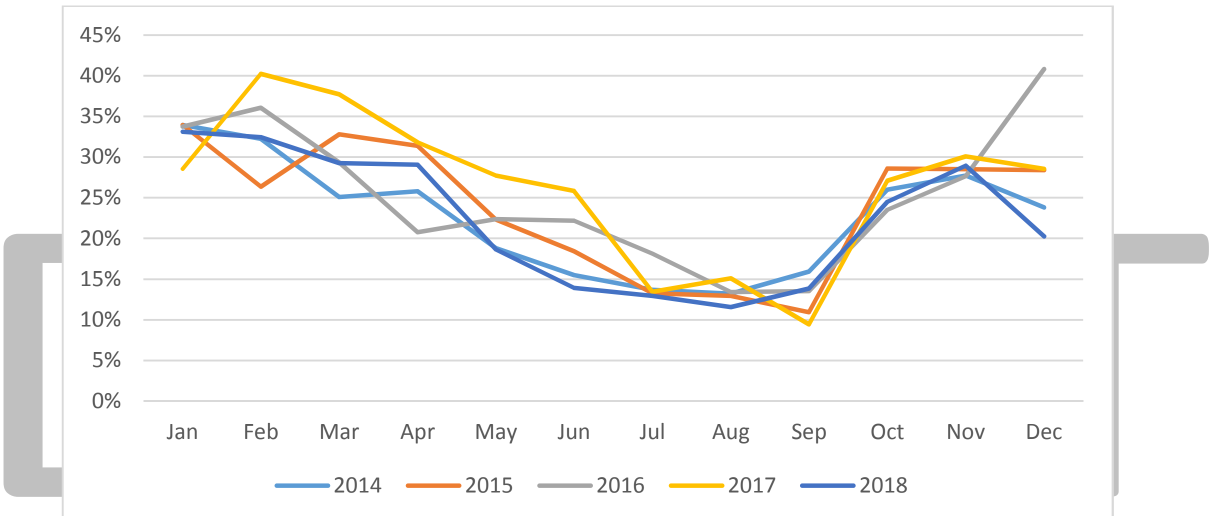
[7] *See* slides 12 – 32 of the following presentation http://nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20223/AI%205'%20-%20windsolar-v04.pdf

information, see the *2020 IRM High Renewable Sensitivity Assumptions*[8] presented to NYSRC. Note: Due to the variety of sources and years of data, the potential for coincident performance of different generation technologies was not evaluated in this study.

Performance Data and Unforced Capacity Ratings

NYISO currently credits incremental renewable generation based upon their Unforced Capacity ("UCAP") ratings, which in turn are derived from their average capacity factors during peak summer hours. Figures 2 through 4 below present projected performance data of each type of resource, which were derived from the data discussed above for hours between 2 p.m. and 6 p.m. for each month[9].

Figure 2- Onshore Wind Capacity Factor from 2PM to 6PM



[8]http://nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20223/AI%205'%20-%20windsolar-v04.pdf

[9] Results were calculated in accordance with guidelines set forth in section 4.5 of the NYISO Installed Capacity Manual https://www.nyiso.com/documents/20142/2923301/icap_mnl.pdf/234db95c-9a91-66fe-7306-2900ef905338?t=1569860506857

Figure 3- BTM (Solar) PV Capacity Factor from 2PM to 6PM

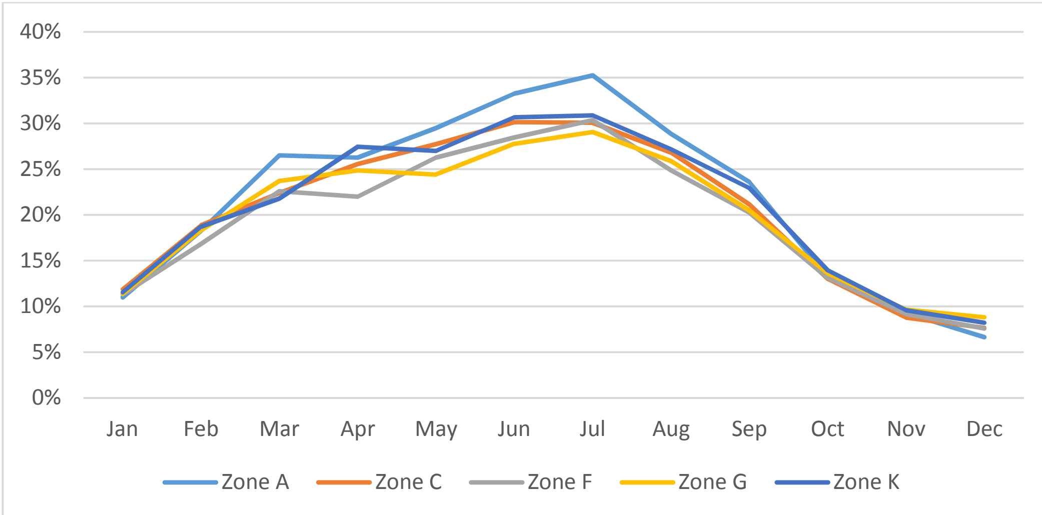
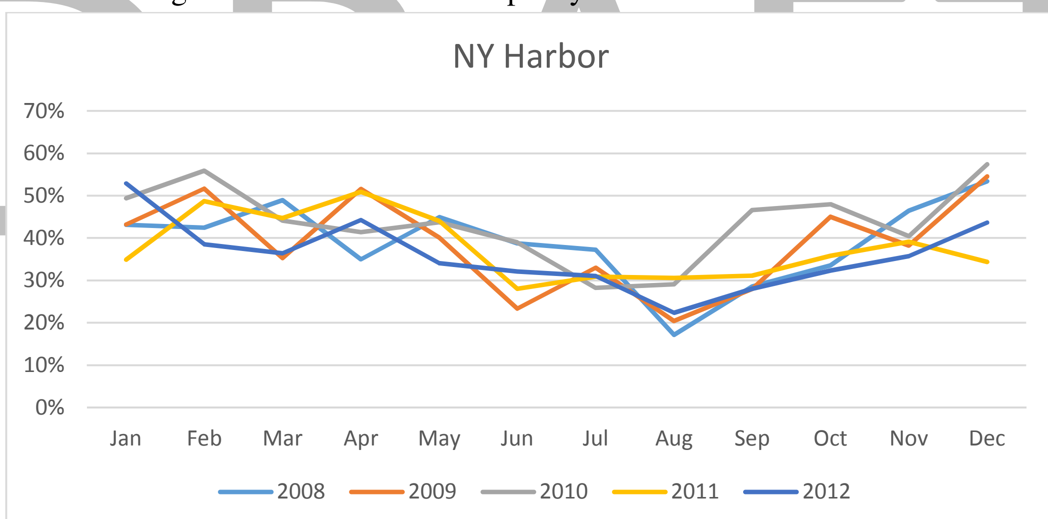
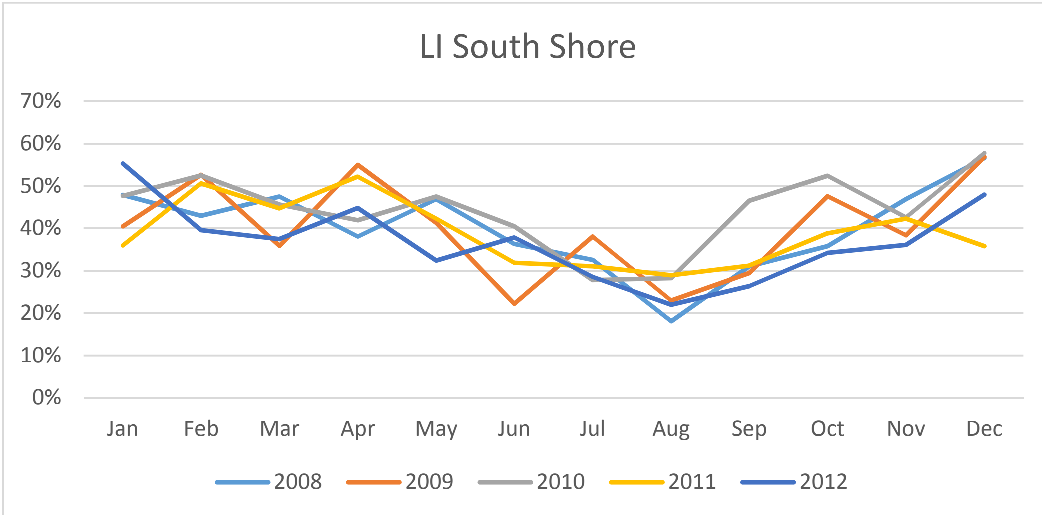
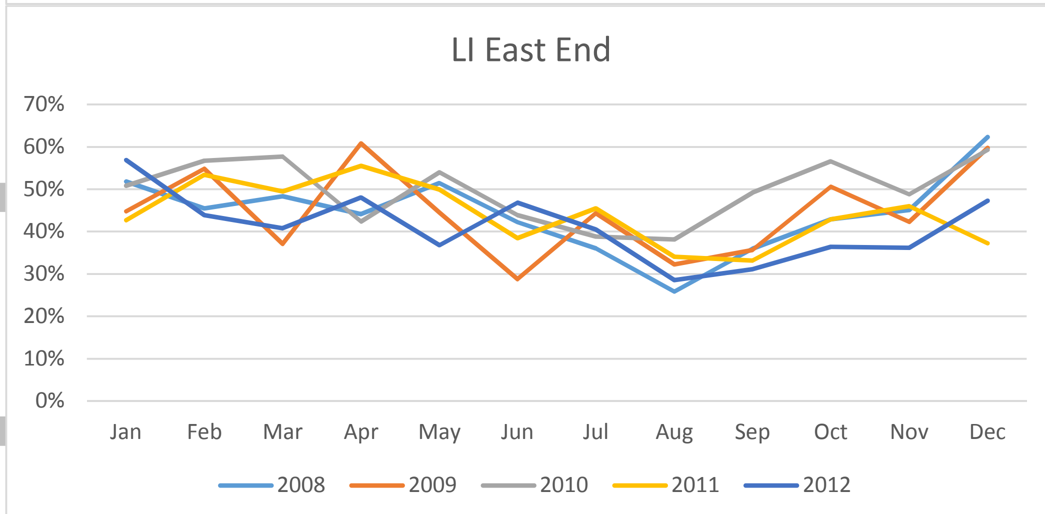


Figure 4- Offshore Wind Capacity Factor from 2PM to 6PM







The NYISO calculated corresponding summer zonal EFORds and UCAP ratings for these resources in accordance with guidelines set forth in section 4.5 of the NYISO Installed Capacity Manual. The data are provided in Tables 3 and 4 below.

Table 3- Zonal Production Factors of by Resource Type

Zone	BTM PV	On-Shore Wind	Off-Shore Wind
A-C	31%	15%	
D		14%	
E		17%	
F	28%		
G	28%		
J			29%
K	30%		34%
NYCA	**29%**	**16%**	**32%**

Table 4- UCAP added to PBC Assumptions by Resource Type(MW)

Zone	BTM PV	On-Shore Wind	Off-Shore Wind	Total UCAP
A-C	401	312		**713**
D		123		**123**
E		186		**186**
F	525			**525**
G	123			**123**
J			588	**588**
K	113		673	**788**
Total	**1,164**	**621**	**1,261**	**3,046**

Table 5 illustrates the effect that the addition of intermittent resources has on zonal and system-wide EFORds.

Table 5- System Zonal EFORds by Study

Area	PBC EFORds	High Renewable EFORdS
A	5%	28%
B	7%	7%
C	11%	24%
D	34%	50%
E	55%	69%
F	8%	37%
G	15%	23%
H	4%	4%
I	0%	0%
J	10%	21%
K	10%	27%
NYCA	**12%**	**26%**

Results

The high renewable resources case Tan45 analysis yielded an Installed Reserve Margin (IRM) of 42.9%, with corresponding locational capacity factors in Zones J and K of 97.9% and 131.6%, respectively.

Included in this analysis is a metric called the Unforced Capacity Reserve Margin, or URM. This value is the IRM translated to an UCAP basis considering the NYCA-wide forced outage ratings, based on the average of all capacity suppliers' forced outage ratings. The URM reported below uses forced outage rates consistent with the IRM study. For example, the forced outage rate is based on five-year performance data. The URM relates to the IRM through the following equation:

$$URM\ Requirement = \left[\left(1 + \frac{IRM\ Requirement\ (\%)}{100}\right) \times \left(1 - \frac{System\ EFORd\ (\%)}{100}\right) - 1\right] \times 100\%$$

$$URM = [(1 + 0.429) \times (1 - 0.264) - 1] \times 100\%$$

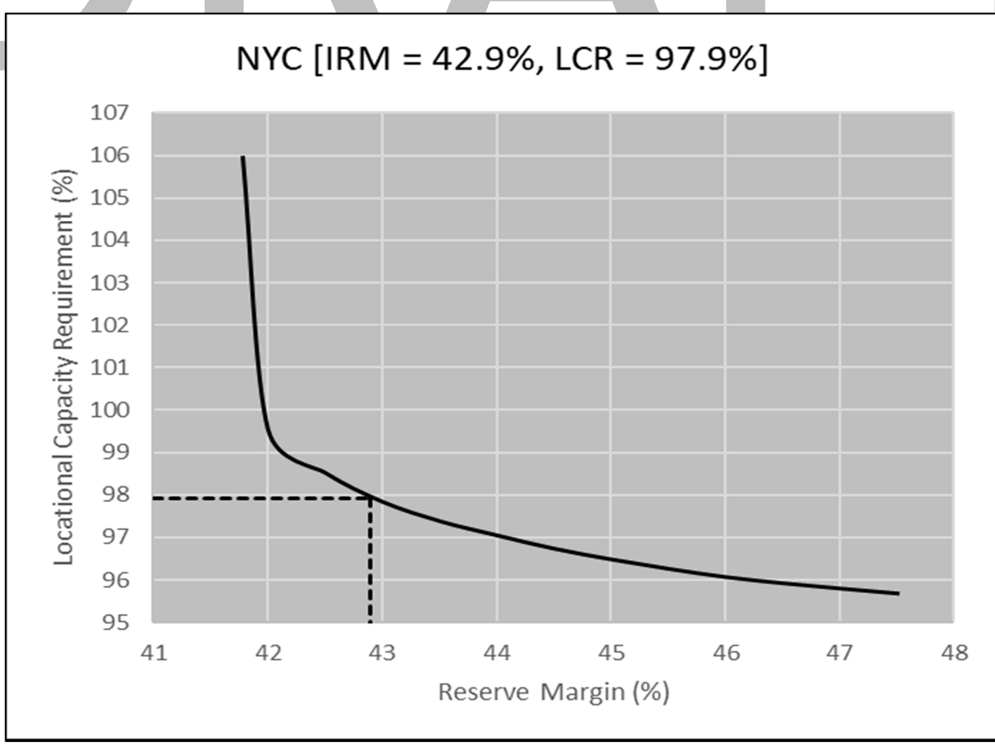
$$URM = 105.1\%$$

In comparison to the PBC's results, the High Renewable study yields a significantly higher IRM, in addition to significantly higher corresponding locational capacity factors. The IRM and LCRs are measured in terms of Installed Capacity. The URM, which is measured in terms of UCAP, rises slightly. Detailed comparison of the results of the two studies can be seen in Table 6.

Table 6- Resources Necessary to Meet 0.1 LOLE Standard as Percentage of Peak Load

Case	Statewide	URM	NYC	NYC URM	Long Island	LI URM
PBC	118.6%	104.7%	83.9%	75.5%	102.3%	92.1%
High Renewable	142.9%	105.1%	97.9%	77.8%	131.6%	95.5%

Figure 5- High Renewable Tan45 Curves



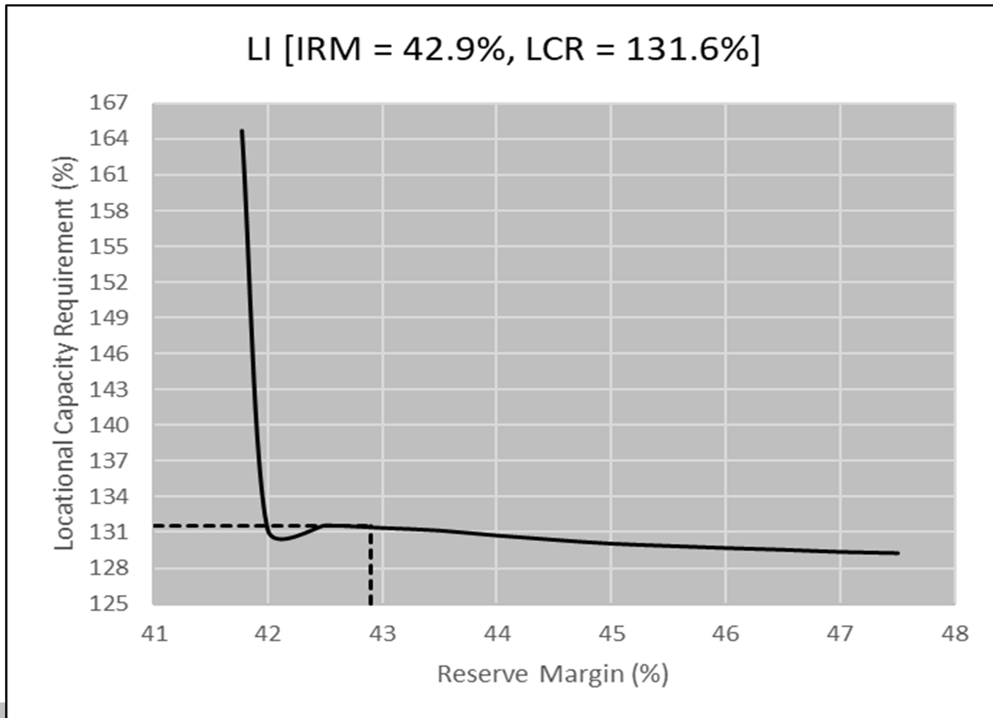


Figure 5 displays the Tan45 curves for both Zones J and K. The flatness of both curves suggests that, in this scenario, certain minimum levels of downstate capacity will be required (e.g., >130% of peak load in Long Island and >95% of peak load in New York City) regardless of the NYCA-wide reserve margin. These minimum capacity levels are substantially higher than historic Locational Minimum Installed Capacity Requirements for each Locality. The study also shows that the amount of needed UCAP will have a slight increase with the addition of significant renewables.

Additional metrics to gauge the reliability value changes in this scenario can be found in Table 7.

Table 7- Statewide changes from PBC to High Renewable Case

NYCA	Preliminary Base Case	High Renewable Sensitivity	Deltas
As Found[10] ICAP (MW)	42,465	54,465	+12,000
ICAP @ LOLE =0.1 (MW)	38,251	46,088	+7,837
ICAP Removed (MW)	4,213	8,376	+4,163
UCAP Removed (MW)	3,720	6,162	+2,442

[10] "As found" here refers to the sum of subtotal capacity of all internal NYCA generating units, contracts and net capacity imports with external control areas, and capacity associated with special care resources

Zone J			
As Found ICAP (MW)	10,348	12,348	+2,000
ICAP @ LOLE =0.1 (MW)	9,775	11,406	+1,631
ICAP Removed (MW)	573	942	+369
UCAP Removed (MW)	515	749	+233
Zone K			
As Found ICAP (MW)	6,133	8,521	+2,388
ICAP @ LOLE =0.1 (MW)	5,292	6,807	+1,515
ICAP Removed (MW)	841	1,714	+873
UCAP Removed (MW)	760	1,244	+484

This data shows that, for this scenario, adding 12,000 MW of intermittent renewables allows the approximate removal of an additional 4,200 MW of existing non-renewable ICAP and 2,400 MW of existing non-renewable UCAP from the NYCA system. Further, the addition of 4,388 MW of intermittent renewables downstate allows the removal of approximately 1,200 MW of ICAP and 700 MW of UCAP.

Most of the increase in the IRM and LCRs is a result of the lower availability of the intermittent resources that were added in the study.

It was observed that the change in UCAP was not consistent with the expectation that there should be no change in needed UCAP. For example, the study assumed 3,046 MW of UCAP added to the NYCA under existing unforced capacity rating methodologies, but this approach only allowed for the elimination of 2,442 MW of existing UCAP to meet the resource adequacy criterion.

Likewise, New York City and Long Island were assumed to increase by 588 MW and 788 MW of UCAP respectively, but those additions only enabled eliminating 233 MW and 344 MW of UCAP in Zones J and K respectively to meet the resource adequacy criterion.

Conclusions

1. This NYSRC high renewable resources study shows that adding a hypothetical 12,000 MW (4,000 MW each of FTM PV, onshore wind, and offshore wind) increases the installed reserve margin needed to meet New York State’s reliability standards by 24.3 percentage points, from the 18.6% 2020 IRM Study preliminary base case value to 42.9%. This study also determined corresponding increases in locational capacity factors of 14.0 and 29.3 percentage points for New York City and Long Island, respectively.

2. New York's requirement of meeting 70% of its energy needs from renewable resources by the year 2030 will require additions of roughly twice the amount of intermittent resources considered in this analysis.
3. The increase in the Installed Reserve Margin is driven by the intermittent characteristics of weather-dependent resources. The amount of the increase is predominantly a result of the lower availability of intermittent generators reducing the average availability of NYCA suppliers. If the introduction of the additional renewable resources was accompanied by the retirement of higher availability traditional dispatchable resources, the average availability of the fleet would decline more, and the IRM and LCRs would correspondingly increase.
4. The efficacy of the renewable resources used in this study decreased with increased penetration rates as shown by the drops in UCAP values. The mechanism for this decreased has not yet been determined.

<u>Recommendations</u>

1. The study shows that 3,046 MW of UCAP resources would be added to the NYCA under existing unforced capacity rating methodologies, but that this addition allowed for the elimination of only 2,442 MW of UCAP to return the system to criteria. Likewise, NYC and Long Island were assumed to add 588 MW and 788 MW of UCAP respectively for the analysis, but those additions only enabled eliminating 233 MW and 344 MW of UCAP respectively to return the system to criteria. These results indicate that the reliability value of the added intermittent resources was less than expected and indicates a need for further analysis to understand what is driving the result.
2. The State also has plans for substantial Energy Storage Resources (ESR) that was not evaluated as part of this study. As MARS capability of modeling storage resources is improved, modeling of ESR should be added to future studies.
3. This study was performed using non-coincident annual generation shapes for FTM PV, onshore wind, and offshore wind. As more annual generation data is developed, these resource shapes should be aligned so that the study can evaluate the reliability risk of coincident periods of low renewable generation.
4. This study should be performed periodically as a function of experience with intermittent resources and plans for future developments. Additionally, the analysis should be refined as clean energy plans are further developed that include electrification of the entire economy, aggressive energy efficiency and higher customer load response, transmission expansion and reinforcements, and increases in renewable resources and energy storage and modeling of those resources.

Appendix – Additional Thoughts on Future Actions

- This analysis did not consider the need for additional transmission for transferring renewable energy to the grid. The comparatively high NYC (97.5%) and LI (131.6%) LCRs from the analysis illustrate this need. Future studies should consider this issue.
- The NYSRC and NYISO will need to examine the NYCA system risks that could occur under extreme but realistic contingencies associated with wind and solar resources because of the high level of uncertainty of weather and other factors that could impact their availability.
- Increasing ramping requirements will be needed because of the variability of high levels of renewable resources. We need to identify the resources necessary to meet such ramping concerns.
- The white paper should highlight the significant adverse UCAP impacts associated with high renewable penetration (*see* Recommendation 1 above), particularly in downstate New York.
- The method for computing the availability of intermittent renewable resources should be examined further.

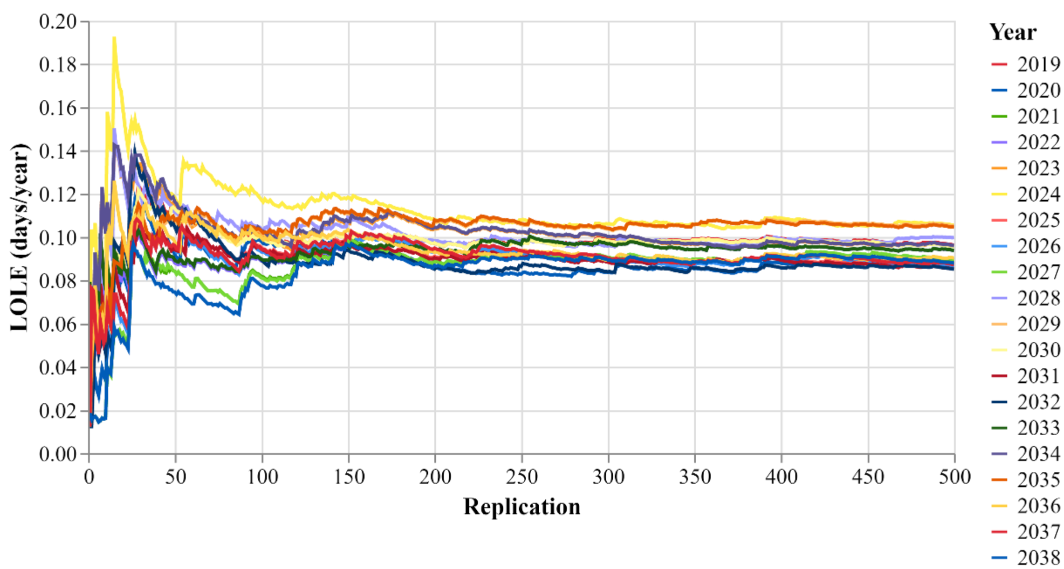
Installed Capacity Subcommittee

Whitepaper Scope for Changing the Study Year in MARS

Problem: The goal of changing the study year is to update the year to be analyzed in the GE Multi-Area Reliability Simulation ("MARS") software, while changing nothing else in the master input file ("MIF"). Some Loss of Load Expectation ("LOLE") changes are expected due to the shifting of load against the resource shapes of intermittent generators, as well as changing the underlying maintenance profile. However, during the last IRM study process, the NYISO observed counterintuitive results when changing the study year. Updating the simulation year from 2019 to 2020 resulted in an unexplainable drop in LOLE. This caused the NYSRC Installed Capacity Subcommittee ("ICS") to maintain the 2019 study year parameter[1] for the 2020 IRM Study.

Scope: GE recommended the temporary workaround used for the 2020 IRM Study, which was to hold the study year constant. The company committed to adding functionality to set a specific start day for a study year. The goal of diving further into this issue is to develop a recommendation on how we treat the study year parameter. The white paper analyzes the year-over-year variability in LOLE by changing the study year, testing the new MARS functionality of keeping a constant start day of the year, and take in to consideration potential other options to mitigate the counterintuitive results. We expect to recommend to the ICS and the Executive Committee a change for the 2021 IRM study. The latest MARS version, which includes the new start day functionality, is being tested.

Results from GE Study discussed at ICS Meeting #222 – NY LOLE when changing the study year



[1] ICS Meeting Minutes from study year discussion: http://nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20223/ICS%20Meeting%20222_R1%5b10303%5d.pdf

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Installed Capacity Subcommittee

Whitepaper Scope for Intermittent Resource Production Correlation

Problem Statement

The NYSRC Executive Committee ("EC") is committed to understanding the impact of high renewable resources penetration on the reliability of the New York bulk power system. As such, the NYSRC Installed Capacity Subcommittee ("ICS") established a project scope, modeling assumptions, performed modeling and analysis, and reported draft results to the NYSRC EC and ICS on a case in which 12,000 MW of intermittent, weather-dependent resources (*i.e.*, solar PV, onshore wind, offshore wind) were added to the 2020 IRM Study Preliminary Base Case assumptions. The NYSRC ICS expressed interest in evaluating the degree to which weather-dependent resource production correlates over a coincident period to determine how these correlations affect New York bulk power system reliability.

Project Scope

The NYSRC ICS will evaluate whether a correlation of onshore wind, solar, landfill gas, and run of river hydro exists during low renewable generation periods and, if so, whether such correlation is important to model in the IRM Study. The ICS will then evaluate correlation of onshore wind production data (*i.e.*, NYISO billing quality meter data) and offshore wind production, as determined for the High Renewable Whitepaper. The comparison will focus on the 2010 – 2012 period based on data availability.

Project Deliverables

The NYSRC ICS will produce a whitepaper summarizing the problem statement, project scope, data sources, correlation evaluation methods, and justification of both those data source and methods. The whitepaper will also include a test of the 2020 IRM Final Base Case when onshore wind and solar PV data are drawn from the same year (*e.g.*, 2015 wind data is always paired with 2015 solar data; 2016 wind data is always paired with 2016 solar data). The whitepaper will make recommendations on the adoption of intermittent generation production correlation data in the 2021 IRM study, as well as a similar analyses of both; 1) the correlation of onshore wind, solar, landfill gas, and run of river hydro, and 2) the correlation of onshore wind and offshore wind production.

Finally, the ICS will study using more than five years of intermittent resource production data to determine whether modeling correlation data would diminish year-over-year IRM volatility while also capturing a broader sample of renewable resource production data in the MARS model. The ICS would likely issue a final whitepaper in 2021.