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Independent System Operator

2020 RNA: Preliminary Results for 70x30 Scenario

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Agenda

- **Scenario Background**
- **Preliminary Scenario Results**
  - Resource Adequacy Analysis
  - Transmission Security Analysis
- **Appendices**
  1. 70x30 Load and Resources Totals
  2. GE MARS Energy Limited Type 4 (EL4) Description and Modeling
  3. June 19, 2020 ESPWG/TPAS slides containing the 70x30 RNA assumptions

2020 RNA Scenario Background

- **The 2020 RNA is evaluating several scenarios initially discussed at ESPWG on February 27, 2020 [link]**
- **Scenarios are provided for information only, and do not lead to Reliability Needs identification or mitigation**
  - One of the objectives of the Reliability Planning Process is to identify, through the development of appropriate scenarios, factors and issues that might adversely impact the reliability of the Bulk Power Transmission Facilities (BPTF)

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70x30 Scenario

- The CLCPA mandates that 70% of New York's end-use energy consumption be served by renewable energy by 2030 ("70x30"), including specific technology-based targets for distributed solar (6,000 MW by 2025), storage (3,000 MW by 2030), and offshore wind (9,000 MW by 2035)
- The "70x30" scenario models these targets through 2030 for two potential load forecasts
- The 70x30 scenario is not intended as a roadmap for compliance with the mandates of the CLCPA, but does provide insights into system impacts that may occur as the resource mix changes
- Renewable capacity build-out assumptions were developed in collaboration with stakeholders utilizing the NYISO interconnection queue as a reference point

RNA 70x30 Scenario Background

- **The RNA 70x30 scenario models are based on the 2019 CARIS 70x30 scenario assumptions and output information**
  - The 2019 CARIS Report is available on the NYISO website [link]
- **The CARIS 70x30 scenario analyzed the system congestion and constrained generation pockets that arise from implementing 70% renewable energy on the New York system by 2030**
- **The purpose of this analysis is to augment the effort with reliability perspectives on potential system changes undertaken to meet state policy goals**
  - Additional assumptions details are in Appendix C of this presentation

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RNA 70x30 Scenario Assumptions, *cont.*

- **The major assumptions for the RNA 70x30 scenario were presented at June 19 ESPWG/TPAS**
  - Link to the 70x30 scenario assumptions presentation (also copied as Appendix 3 of this presentation)
  - Link to the Assumptions Matrix
- **For the RNA 70x30 scenario cases, the compensatory MW used in CARIS were not included in the model in order to test the system against the reliability criterion**
  - In the prior RPP, the 2019 – 2028 CRP identified compensatory MW to bring the system under an LOLE of 0.100 dy/yr
  - These generic units were added in Zones J and K

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70x30 Scenario: Resource Adequacy

Resource Adequacy Analysis Assumptions

- **The 2019 70x30 CARIS "Base Load" and "Scenario Load" simulations provided the 8,760 hourly profiles for load and renewables as input into the RNA resource adequacy scenarios**
  - As presented at the June 19, 2020 ESPWG/TPAS (also, see Appendix 3)
- **The MARS topology was updated to restrict flows from Zone K to Zone J (J_TO_K interface), due to unit retirement assumptions:**
  - Added a Dynamic Limit dependent upon Barrett Steam unit availability
    - J_to_K limit into Zone J when no Barrett Steam units are available: 355 MW
    - J_to_K limit into zone J for all other conditions: 505 MW
  - Note: the RNA Base Case limit is 505 MW and independent of Barrett Steam unit availability

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Resource Adequacy Analysis Steps

1. **Model the CARIS 70x30 "Base Load" and "Scenario Load" along with their corresponding renewable resources mix and calculate NYCA LOLE**
   - Identify Zonal Resource Adequacy Margin (ZRAM)
2. **For each load model, if the system has surplus resources (LOLE less than 0.1) then remove fossil plants based on age until NYCA exceeds the LOLE criterion ("model at criterion")**
   - This age-based approach is a simple analytical approach as a proxy to represent unit retirements that may occur as surplus resources increase. In reality many factors will affect specific generator status decisions.
   - Quantify (MW) fossil plant removals that may be possible while maintaining resource adequacy

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Step 1 – Initial LOLE Results

- **This step evaluates the NYCA LOLE for the system when:**
  - Renewable resources are added
  - Exports from Zone K to Zone J have been reduced due to unit availability

Cases	NYCA LOLE
70x30 2019 CARIS ‘Base Load’	0.00
70x30 2019 CARIS ‘Scenario Load’	0.00

- **The observed LOLE is effectively 0.00 for several reasons, including:**
  - The inclusion of a substantial amount of renewable resources
  - No fossil generation being retired
  - Utilization of a different load shape than the RNA Base Case
  - No changes to the transmission systems due to increased renewable penetration

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Step 1 – ZRAM Results on Initial Case

- **ZRAM analysis identifies the amounts of generic "perfect capacity" resources that can be removed from a zone while still meeting the LOLE criterion**
  - "Perfect capacity" is capacity that is not derated (*e.g.*, due to ambient temperature or unit unavailability), not subject to energy duration limitations, and not tested for transmission security or interface impacts. Actual resources would need to be larger in order to achieve the same impact as perfect-capacity resources.
  - ZRAM was previously referred to as "Zonal Capacity at Risk (ZCAR)" in prior RNA analyses

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Step 1 – ZRAM Results on Initial Case, *cont.*

Cases	NYCA LOLE	ZRAM Zone A	ZRAM Zone B	ZRAM Zone C	ZRAM Zone D	ZRAM Zone E	ZRAM Zone F	ZRAM Zone G	ZRAM Zone H	ZRAM Zone I	ZRAM Zone J	ZRAM Zone K
70x30 2019 CARIS 'Base Load'	0.00	-2,400	EZR	EZR	-1,750	EZR	EZR	EZR	EZR	EZR	-1,500	-1,250
70x30 2019 CARIS 'Scenario Load'	0.00	-3,550	EZR	EZR	-1,750	EZR	EZR	EZR	EZR	EZR	-4,200	-1,400

Notes:

- Negative numbers indicate the amount of MW that can be removed from a zone without causing a violation
- EZR - exceeds zonal resources (all generation can be removed without causing a violation)
- The generation pockets in Zone J and Zone K are not modeled in detail in MARS and the values identified here may be larger as a result

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Step 2 – Age-Based Fossil Removal Simulations

- **Unlike MAPS, MARS does not utilize unit commitment and all generation is assumed to be available if the unit not on an outage**
- **To compensate for this program limitation, this analysis evaluates the impact of making select generation resources unavailable, using age as a proxy for the priority order of retiring units**
  - Unit Age is calculated using the In-Service Date from Table III-2 in the 2020 Gold Book, as compared to May 1, 2030
  - This analysis makes successive retirements until the LOLE exceeds the criterion; the analysis is performed for each load case
- **This analysis does not consider the impact of transmission or transfer limit changes that may result from the unit retirements**

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Step 2 – Fossil Removal on "Base Load"

	Total Thermal Capacity (MW)				Cumulative Capacity Removed (MW)				
Cases (Age >=)	Zone J	Zone K	Other Zones	Total	Zone J	Zone K	Other Zones	Total	NYCA LOLE
Total	8,190	3,962	15,012	27,165	0	0	0	0	0.00
70	6,978	3,564	14,616	25,160	1,212	398	396	2,005	0.02
68	6,601	3,371	14,616	24,590	1,589	591	396	2,575	0.05
67*	6,386	3,360	14,616	24,364	1,804	602	396	2,801	0.11
67	6,236	3,360	14,616	24,214	1,954	602	396	2,951	0.15

Observations

- NYCA meets the LOLE criterion with 2,575 MW removed
- NYCA exceeds the LOLE criterion when 2,801 MW are removed (67*)
  - The increase in LOLE is primarily driven by Zone J capacity removals

Notes:

- Case 67: most, but not all units 67 and older were retired in this case
- Case 67*: a special evaluation of Case 67 where the marginal unit was derated instead of fully removed to obtain an LOLE closer to 0.1 days/year

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Step 2 – Fossil Removal on "Scenario Load"

	Total Thermal Capacity (MW)				Cumulative Capacity Removed (MW)				
Cases (Age >=)	Zone J	Zone K	Other Zones	Total	Zone J	Zone K	Other Zones	Total	NYCA LOLE
Total	8,190	3,962	15,012	27,165	0	0	0	0	0
50	4,354	1,541	11,228	17,124	3,836	2421	3784	10,041	0.03
40	4,354	1,393	10,247	15,995	3,836	2569	4765	11,170	0.07
39	4,354	1,349	10,197	15,901	3,836	2613	4815	11,264	0.09
38	3,563	1,325	9,935	14,824	4,627	2637	5077	12,341	0.11

Observations

- NYCA meets the LOLE criterion with 11,264 MW removed
- NYCA exceeds the LOLE criterion when 12,341 MW are removed

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Nuclear Retirement Sensitivity

- The nuclear generation fleet, which is comprised of the Nine Mile I, Nine Mile II, Ginna and FitzPatrick facilities, are expected to continue in operation until at least March 2029 under the state support provided by Zero Emission Credit Requirements contained in the Clean Energy Standard.
- This sensitivity examines what may be the impacts on the system generation output if those units discontinued operations under the "Base Load" and "Scenario Load" conditions in 2030
  - This analysis first removes the nuclear units (a total of 3,343 MW summer capability), and then the thermal plants by age until the LOLE criterion is violated
  - These units may continue in operation beyond 2029 and this sensitivity analysis should not be interpreted as forecasting their deactivation.

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Nuclear Retirement Sensitivity: "Base Load"

	Total Thermal Capacity (MW)				Cumulative Capacity Removed (MW)				
Cases (Age >=)	Zone J	Zone K	Other Zones	Total	Zone J	Zone K	Other Zones	Total	NYCA LOLE
Total	8,190	3,962	11,669	23,822	0	0	**3,343	3,343	0.00
70	6,978	3,564	11,273	21,817	1,212	398	3,739	5,348	0.02
68	6,601	3,371	11,273	21,247	1,589	591	3,739	5,918	0.06
67*	6,386	3,360	11,273	21,021	1,804	602	3,739	6,144	0.11
67	6,236	3,360	11,273	20,871	1,954	602	3,739	6,294	0.17

Observations

- NYCA meets the LOLE criterion with 5,918 MW removed
  - 5,918 - 3,343 nuclear = 2,575 MW fossil removed with or without nuclear
- NYCA exceeds the LOLE criterion when 6,144 MW are removed (at 67*), of which **3,343 MW nuclear units, and 2,801 MW fossil
  - 3,343 MW of retirement of the nuclear units (all upstate) does not significantly impact the LOLE results, nor the amount of fossil units further removed by age (same 2,801 MW), because the needs are driven by downstate capacity removals

Notes:

- Case 67: most, but not all units 67 and older were retired in this case
- Case 67*: a special evaluation of Case 67 where the marginal unit was derated instead of fully removed to obtain an LOLE closer to 0.1 days/year

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Nuclear Retirement Sensitivity: “Scenario Load”

	Total Thermal Capacity (MW)				Cumulative Capacity Removed (MW)				
Cases (Age >=)	**Zone J**	**Zone K**	**Other Zones**	**Total**	**Zone J**	**Zone K**	**Other Zones**	**Total**	**NYCA LOLE**
Total	8,190	3,962	11,669	23,822	0	0	**3,343	3,343	0.00
50	4,354	1,541	7,885	13,781	3,836	2421	7,127	13,384	0.04
45	4,354	1,541	7,010	12,906	3,836	2421	8,002	14,259	0.07
41	4,354	1,526	7,002	12,883	3,836	2436	8,010	14,282	0.08
40	4,354	1,393	6,904	12,652	3,836	2569	8,108	14,513	0.14

Observations

- **NYCA meets the LOLE criterion with 14,282 MW removed**
  - 14,282 – **3,343 nuclear = 11,170 MW fossil removed vs 11,264 MW fossil removed when nuclear units are in (slide 15)
- **NYCA exceeds the LOLE criterion when 14,513 MW are removed**
  - Retirement of the nuclear units reduces by around 1,170 MW of how much capacity can be removed from the downstate region before encountering a criterion violation: 14,513 - **3,343 = 11,170 MW fossil removed vs 12,341 MW when nuclear units are in (slide 14)

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Energy Storage Sensitivity

- For each load model, with the model at criterion, add 3,000 MW of Energy Storage Resources (ESRs) based on the zonal distribution from the CARIS 70x30 ESR sensitivity, and recalculate NYCA LOLE
  - Identify if additional fossil plants can be retired
  - See Appendix 2 for details on the energy storage modeling

Energy Storage Sensitivity Results

- The table below identifies the amount of fossil capacity that will cause an LOLE criterion violation when removed from the system
- The addition of ESRs allows for additional fossil generation to be removed
  - NOTE: These values should not be used to approximate the effective load carrying capability (ELCC) of the ESRs because the case was not well conditioned for this type of assessment (initial and final LOLEs were not 0.1)

		Nuclear Unit Status	
		In-Service	**3,343 MW Out-Of-Service**
Base Load	Without ESRs	2,801	2,801
	With 3000 MW ESRs	3,062	3,037
Scenario Load	Without ESRs	12,341	11,170
	With 3000 MW ESRs	13,233	11,550

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Sensitivity on Renewable Curtailments

- **The scenario results include the impact of curtailments on renewable resources**
  - The location and timing of the curtailment events are based upon the simulated curtailments from the 2019 CARIS 70x30 Scenario
- **The NYISO performed additional sensitivity analysis to determine if modeling the renewable resources without curtailments would have an impact on the observed LOLE. The change in LOLE resulting from this sensitivity was insignificant.**
- **This result demonstrates that alleviating the local constraints that cause the curtailments, while beneficial from an annual energy production perspective as shown in CARIS, does not offset the need for dispatchable generation to meet reliability requirements at peak load.**

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Resource Adequacy Key Takeaways

- **The NYCA system is reliable when adding new resources, but:**
  - Becomes unreliable as existing fossil generators are removed from service
  - This analysis does not consider potential reliability impacts due to:
    - Intra-zonal constraints on the transmission system
    - Changes on the transmission system as a result of the resource additions or subtractions
    - Unit Commitment, ramp rate constraints, and other production cost modeling techniques
- **Retirement of nuclear units may require additional (or removal of less) fossil fuel generation in order to have a reliable system**
- **Modeling ESRs provides a benefit to the system by:**
  - Allowing for additional units to be retired, subject to the limitations identified above
- **Alleviating the local transmission constraints that cause renewable curtailments, while beneficial from an annual energy production perspective as shown in CARIS, does not offset the need for dispatchable generation to meet reliability requirements at peak load.**

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70x30 Scenario: Transmission Security

70x30 Scenario Assumptions

- The purpose of this assessment is to identify reliability risks focusing on thermal loading of the BPTF for N-1 and N-1-1 conditions
- Transmission security assesses under steady state conditions various dispatches of renewable resources and different load levels
- The starting dispatch for all assessments (except Case 2) begin with renewable dispatches reflecting similar conditions observed in the CARIS 70x30 simulations
  - Case 2 evaluates the impact of a shifting the peak hour due to increased BtM solar
- The age-based fossil removals discussed in resource adequacy were also modeled in this assessment

Case #	Case Load (Net Load including BtM solar reductions, MW)	Land-Based Wind (% of Pmax)	Off-Shore Wind (% of Pmax)	Solar (% of Pmax)
1	Day Peak Load (30,000)	10	20	45
2	Evening Peak Load (31,100)	0	0	0
3	Light Load (12,500 MW)	15	45	0
4	Light Load (12,500 MW)	0	0	0
5	Shoulder Load (21,500 MW)	0	0	40
6	Shoulder Load (21,500 MW)	15	45	40

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Analysis Results

- **Cases 1 and 2 show N-1 and N-1-1 BPTF thermal loading criteria violations in the Con Edison area**
  - Case 2 also shows N-1-1 thermal loading criteria violations in Long Island
- **Cases 3, 4, 5, and 6 show no N-1 or N-1-1 BPTF thermal loading criteria violations**

Case 1 and 2

- **The N-1 analysis observed thermal issues on the following circuits for Case 1:**
  - Rainey 345/138 kV (8W)
  - Rainey 345/138 kV (8E)
- **The N-1 analysis observed thermal issues on the following circuits for Case 2:**
  - Rainey 345/138 kV (8W)

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Case 1 and 2 N-1-1 Results

Zone	Owner	Circuit	Observed in RNA Base Results	Case 1	Case 2
G	O&R	Shoemaker-Shoemaker Tap (29)		x	x
G	O&R	Middletown Tap/Shoemaker Tap 345/138 kV		x	x
J	ConEd	Sprainbrook-W49th St 345 kV (51)	x	x	x
J	ConEd	Sprainbrook-W49th St 345 kV (52)	x	x	x
J	ConEd	Dunwoodie-Mott Haven 345 kV (71)	x	x	x
J	ConEd	Dunwoodie-Mott Haven 345 kV (72)	x	x	x
J	ConEd	Mott Haven-Rainey West 345 kV (Q12)	x	x	x
J	ConEd	Mott Haven-Rainey East 345 kV (Q11)	x	x	x
J	ConEd	Goethals-Gowanus 345 kV (26)	x		x
J	ConEd	Goethals-Gowanus 345kV (25)	x		x
J	ConEd	Sprainbrook/Dunwoodie 345/138 kV (N7)	x	x	x
J	ConEd	Sprainbrook/Dunwoodie 345/138 kV (S6)	x	x	x
J	ConEd	Rainey West - Farragut East 345 kV (61)		x	x
J	ConEd	Rainey 345/138 kV (8W)		x	x
J	ConEd	Rainey 345/138 kV (8E)		x	
K	LIPA	Dunwoodie - Shore Rd 345 kV (Y50)			x
K	LIPA	Kings - Pilgrim 138 kV (880)			x
K	LIPA	Kings - West Bus 138 kV			x
K	LIPA	Elwood 2 - Greenlawn 138kV (138-673)			x
K	LIPA	Valley Stream 2 - East Garden City 2 138 kV			x
K	LIPA	Syosset - Greenlawn 138 kV (138-676)			x
K	LIPA	Syosset - Oakwood 138 kV (138-675)			x
K	LIPA	Northport 3 - Pilgrim 138 kV (138-679)			x
K	LIPA	Northport 1 - Pilgrim 138 kV (138-677)			x
K	LIPA	Elwood 1 - Northport 2 138 kV (138-681)			x

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Transmission Security Key Takeaways

- As the thermal loading issues are observed in a peak load case with a high penetration of land-based wind, off-shore wind, and solar, as well as in a peak case without these resources, additional dispatchable resources would be needed in the area to address thermal reliability criteria violations
- The amount of necessary additional dispatchable resources varies from approximately 650 MW in Case 1 to 750 MW in Case 2, determined by adding generic resources to deficient locations
  - These MW additions are not intended to represent specific solutions, as the impact of specific solutions can depend on the type of solution and its location on the grid

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Questions?

Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policymakers, stakeholders and investors in the power system

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Appendix 1:
70x30 Load and Capacity Totals

70x30 2019 CARIS “Base Load” (2019 Gold Book) and 2020 Gold Book Load Comparison

- **The 2019 CARIS was based on the 2019 Gold Book information, while the 2020 RNA Base Case is based on the 2020 Gold Book information. The 70x30 resource adequacy scenario is based on the 2019 CARIS 70x30 assumptions and output data**
  - Every year the data changes based on the information available at the time of each study.
- **Below is a comparison between load and energy from the two, for information.**

Energy	A	B	C	D	E	F	G	H	I	J	K	NYCA
CARIS ‘Base Load’	14,590	9,695	15,394	5,337	7,095	11,312	9,544	2,807	5,881	51,749	19,608	153,012
2020 GB Y2030	13,931	9,461	15,371	5,925	7,176	11,293	8,713	2,994	5,566	49,450	19,894	149,774

Energy Delta	A	B	C	D	E	F	G	H	I	J	K	NYCA
CARIS ‘Base Load’ - 2020 GB Y2030	659	234	23	-588	-81	19	831	-187	315	2,299	-286	3,238

Summer NC Peak	A	B	C	D	E	F	G	H	I	J	K	NYCA CP
CARIS ‘Base Load’	2,537	1,937	2,653	718	1,264	2,197	2,174	637	1,405	11,589	4,730	31,303
2020 GB Y2030	2,748	2,004	2,813	734	1,318	2,353	2,139	660	1,494	11,924	4,690	31,992

Summer NC Peak Delta	A	B	C	D	E	F	G	H	I	J	K	NYCA CP
CARIS ‘Base Load’ - 2020 GB Y2030	-211	-67	-160	-16	-54	-156	35	-23	-89	-335	40	-689

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70x30 "Base Load" and Capacity Totals, ICAP vs UCAP MW

NYCA Totals	70x30 "CARIS Base Load" (ICAP)	70x30 "CARIS Base Load" (UCAP)[1]
Load (net of BtM Solar)	**31,303**	**31,303**
CARIS Renewable Additions (*offshore&land wind, utility solar)*	30,020	7,861
Total capacity in the 70x30 model before age-based removal[2]	62,837	38,322
Total thermal capacity in the 70x30 model before age-based removal	27,165	25,444
Total fossil units in the 70x30 model before age-based capacity removal	23,822	22,175
Total nukes in the 70x30 model before age-based capacity removal	3,343	3,269
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	2,801	2,629
Total capacity ("model at criterion")	**60,036**	**35,693**
Capacity/ Load Ratio	**191.8%**	**114.0%**

NY_J Totals		
Load (net of BtM Solar)	**11,589**	**11,589**
Total capacity in 70x30 Case	12,510	8,761
Total fossil units in 70x30 model before age-based fossil removal	8,190	7,602
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")**	1,804	1,701
Total capacity ("model at criterion")	**10,706**	**7,060**
Capacity/Load Ratio	**92.4%**	**60.9%**

NY_K Totals		
Load (net of BtM Solar)	**4,730**	**4,730**
Total capacity in 70x30 Case	5,782	4,400
Total fossil units in 70x30 model before fossil removal	3,962	3,745
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")**	602	579
Total capacity ("model at criterion")	**5,180**	**3,821**
Capacity/Load Ratio	**109.5%**	**80.8%**

Notes

1. UCAP calculation:
   - For thermal units, MARS EFORd data is used.
   - For renewables, UCAP is calculated based on the average output during peak hours

2. Reflects additional peakers removal in Zone K

3. Calculated based on Case 67* on Slide 15

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70x30 "Scenario Load" and Capacity Totals, ICAP vs UCAP MW

NYCA Totals	70x30 "CARIS Scenario Load" (ICAP)	70x30 "CARIS Scenario Load" (UCAP)[1]
Load (net of BtM Solar)	**25,312**	**25,312**
CARIS Renewable Additions (*offshore&land wind, utility solar)*	23,407	6,082
Total capacity in the 70x30 model before age-based fossil removal[2]	56,224	36,543
Total thermal capacity in the 70x30 model before age-based removal	27,165	25,444
Total fossil units in the 70x30 model before age-based capacity removal	23,822	22,174
Total nukes in the 70x30 model before age-based capacity removal	3,343	3,269
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	12,341	10,295
Total capacity ("model at criterion")	**43,883**	**26,246**
Capacity/ Load Ratio	**173.4%**	**103.7%**

NY_J Totals		
Load (net of BtM Solar)	**9,129**	**9,129**
Total capacity in 70x30 Case	13,460	8,759
Total fossil units in 70x30 model before age-based fossil removal	8,190	7,602
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	4,627	4,152
Total capacity ("model at criterion")	**8,833**	**4,607**
Capacity/Load Ratio	**96.8%**	**50.5%**

NY_K Totals		
Load (net of BtM Solar)	**3,914**	**3,914**
Total capacity in 70x30 Case	5,782	4,391
Total fossil units in 70x30 model before fossil removal	3,962	3,745
Age-based fossils removed to get to 0.1 LOLE ("model at criterion")[3]	2,637	2,502
Total capacity ("model at criterion")	**3,145**	**1,889**
Capacity/Load Ratio	**80.3%**	**48.3%**

Notes

1. UCAP calculation:
   - For thermal units, MARS EFORd data is used.
   - For renewables, UCAP is calculated based on the average output during peak hours

2. Reflects additional peakers removal in Zone K

3. Calculated based on Case 38 on Slide 17

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Appendix 2:
Energy Storage Modeling in MARS

Modeling Energy Storage Resources in MARS

- **Starting in MARS version 3.29.1499, a new unit type was added to replicate the behavior of an ESR, called an Energy Limited Type 4 (EL4) unit**
  - An EL4 unit is used only when there would be a loss of load event
- **This model extends work performed by GE for their EL3 unit type by adding the capability for the unit to charge from excess generation**
  - At this time, EL4 units model 100% round trip efficiency

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MARS EL4 Unit Type

- **EL4 units can be subject to the following constraints:**
  - Minimum and Maximum hourly generation (MW)
  - Maximum energy discharge per day and month (MWh)
  - Maximum number of days used per month and year
  - Maximum number of hours used per day, month, and year

- **This unit type requires stored MWh in order to be used**
  - The unit will charge if excess generation is available
  - The unit may start the year with a stored charge

Application to the 70x30 Simulations

- Energy Storage units were added according to the zonal distribution to the right →
- Units were modeled with a maximum energy discharge per day of 4x their hourly discharge value
  - This allows the unit to discharge fully in 4 hours, or
  - For longer if not at full discharge

Zone	Hourly Discharge (MW)	Daily Discharge (MWh)
A	150	600
B	90	360
C	120	480
D	180	720
E	120	480
F	240	960
G	100	400
H	100	400
I	100	400
J	1,320	5,280
K	480	1,920
NYCA	**3,000**	**12,000**

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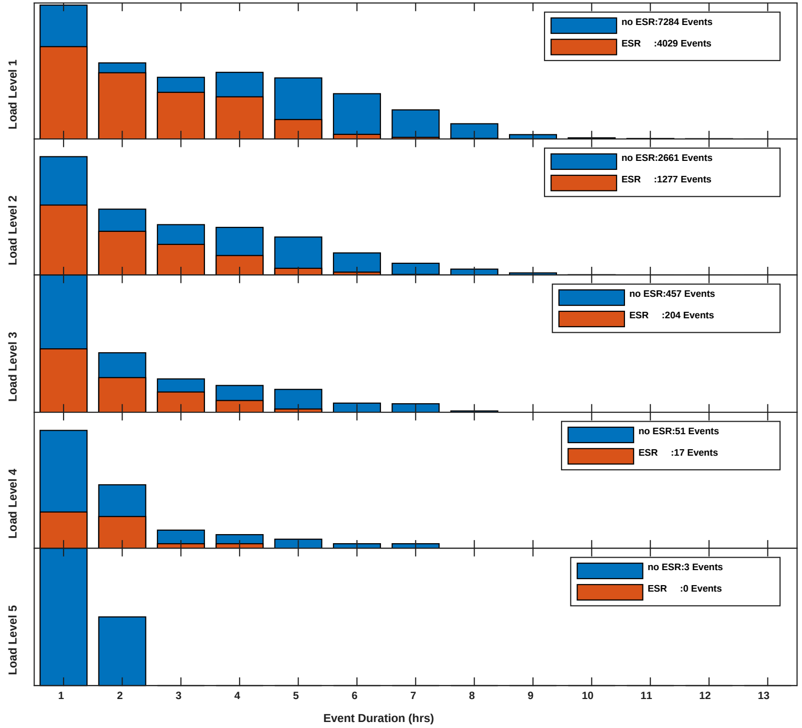
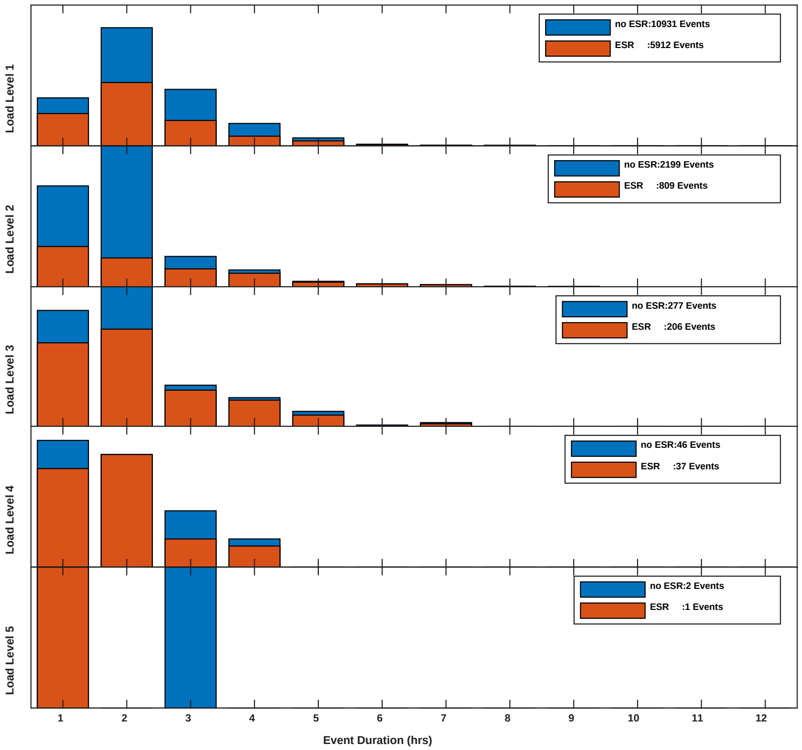
Impact of 4hr ESR on “Base Load” Case

- This slide provides an overview of the impact of ESRs on the case with units aged 67 or older being modeled as retired
  - Specifically this was run on an intermittent case to evaluate the impact of ESRs around an LOLE of 0.100
- Introduction of ESRs shortens long events and abates many short-duration events



Impact of 4hr ESR on “Scenario Load” Case

- This slide provides an overview of the impact of ESRs on the case with units aged 40 or older being modeled as retired (installed on May 1, 1990 and earlier)
- Introduction of ESRs shortens long events and abates many short-duration events



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Appendix 3:
Copy of June 19, 2020 ESPWG/TPAS Presentation [link]

2020 RNA
70x30 Scenarios Assumptions

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Scenarios Background

- One of the objectives of the Reliability Planning Process is to identify, through the development of appropriate scenarios, factors and issues that might adversely impact the reliability of the Bulk Power Transmission Facilities (BPTF)
- This presentation summarizes the 2020 RNA 70x30 CLCPA Scenarios Assumptions
- The RNA 70x30 scenarios will be built off of the 2019 Congestion Assessment and Resource Integration Study (CARIS) Phase I, 70x30 scenarios assumptions

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70x30 CLCPA Background

- **On July 18, 2019, New York's Governor Cuomo signed into law the Climate Act or CLCPA, which mandates that 70% of New York State's end-use energy be generated by renewable energy systems by 2030 ("70x30")**
  - The law also creates a Climate Action Council charged with developing a scoping plan of recommendations to meet these targets and place New York on a path toward carbon dioxide ("carbon") neutrality
- **The 2020 RNA envisions performing scenarios that take into consideration full implementation of one of the CLCPA's policy targets of 70% renewable energy by 2030**
- **CLCPA targets (https://climate.ny.gov/):**
  - 85% Reduction in GHG Emissions by 2050
  - 100% Carbon-free Electricity by 2040
  - 70% Renewable Energy by 2030
  - 9,000 MW of Offshore Wind by 2035
  - 3,000 MW of Energy Storage by 2030
  - 6,000 MW of Solar by 2025
  - 22 Million Tons of Carbon Reduction through Energy Efficiency and Electrification

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2019 CARIS Phase I Background

- **The CARIS Phase I is part of a two-phase Economic Planning Process and provides information such as:**
  - Historic (2014-2018) and projected (2019-2028) congestion on the New York State bulk power transmission system;
  - Analysis of the potential costs and benefits of mitigating that congestion using generic transmission, generation, demand response, and energy efficiency solutions
  - Scenarios, which are variations to evaluate the impact on transmission congestion of changed conditions in the base case assumptions. Scenario analyses can provide useful insight on the sensitivity of projected congestion values to differing assumptions included in the base case
- **The "70x30" scenario is based on the policies set forth in the 70x30 CLCPA; the scenario models two hypothetical build-outs of renewable energy facilities and identifies transmission-constrained pockets throughout New York State that could prevent full utilization of that renewable energy**
- **The 70x30 scenarios are not intended as a roadmap for compliance with the mandates of the CLCPA**

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2020 RNA: 70x30 Scenarios Summary of Major Assumptions

- Resource adequacy and transmission security evaluations will be performed, building off the load shapes and renewable mix assumptions from CARIS
- Load: each of the two load shapes from the 2019 CARIS 70x30 scenarios* are modeled for the MARS resource adequacy 70x30 scenarios:
  - "Base Load": higher energy shape (153 TWh)
  - "Scenario Load": lower energy shape (136 TWh)
- Transmission security analysis will be performed using the CARIS 'Base Load' results
- Renewable resource mix: from the CARIS output for each of the two load models
- External areas: add a 1,310 MW Hydro Quebec to Zone J HVDC tie, consistent with CARIS
- Fossil units removal: staged by age until LOLE violations observed. Those removed resources that bring the NYCA below LOLE of 0.1 days/year will be then modeled as out-of-service in the transmission security assessments
- Storage: zonal MW distribution modeled consistent with CARIS (details in the following slides)

*2019 CARIS I targets July, 2020 for completion

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2020 RNA 70x30 Scenarios: Load Assumptions Summary

RNA 70x30 *"Base Load" from CARIS*	A	B	C	D	E	F	G	H	I	J	K	NYCA
Net Load Energy (GWh)	14,590	9,695	15,394	5,337	7,095	11,312	9,544	2,807	5,881	51,749	19,608	153,012
Net Load Peak (MW)*	2,537	1,937	2,653	838	1,264	2,197	2,174	637	1,405	11,589	4,730	31,303
+ BtM-PV at Zonal Peak (MW)	368	60	556	0	518	584	246	35	35	352	102	2,757
Total Load Peak (MW)	2,905	1,997	3,209	838	1,782	2,781	2,420	672	1,440	11,941	4,832	34,060

RNA 70x30 *"Scenario Load" from CARIS*	A	B	C	D	E	F	G	H	I	J	K	NYCA
Net Load Energy (GWh)	13,034	7,757	12,626	5,101	5,694	9,654	7,911	2,848	5,952	46,354	19,026	135,958
Summer Net Load Peak (MW)*	2,112	1,417	2,171	651	1,052	1,988	1,912	625	1,385	9,129	3,914	25,312
+ BtM-PV at Summer Zonal Peak (MW)	77	16	0	0	0	0	22	2	5	64	24	269
Total Summer Load Peak (MW)	2,189	1,433	2,171	651	1,052	1,988	1,934	627	1,390	9,193	3,938	25,581
Winter Net Load Peak (MW)*	2,234	1,310	2,264	740	1,246	1,934	1,607	636	1,065	7,344	3,841	23,779
+ BtM-PV at Winter Zonal Peak (MW)	0	0	0	0	0	0	0	0	0	0	0	0
Total Winter Load Peak (MW)	2,234	1,310	2,264	740	1,246	1,934	1,607	636	1,065	7,344	3,841	23,779

*Non-coincident zonal peak

2020 RNA 70x30 Scenarios Resource Adequacy Assumptions

RNA 70x30 Scenarios: Two Load Variations

- **CARIS 70x30 "Base Load":**
  - 2002 load shape scaled up to Y2028 energy forecast from the 2019 Gold Book
  - Same load shape used in all MARS load levels
- **CARIS 70x30 "Scenario Load":**
  - 2002 load shape scaled to match CARIS 70x30 Scenario Load Forecast
  - Same load shape used in all MARS load levels

RNA 70x30 Scenarios:

Generation Assumptions Common to Both Load Variations

- **External Areas**
  - HQ to J modeled as a unit in MARS with shape from CARIS output in Zone J
  - HQ to D modeled as a unit in MARS with shape from CARIS output in Zone D
- **Fossil Generation Initial Removal**
  - All peaker units affected by the Peaker Rule were removed in 2023 and 2025 to further align with the CARIS assumptions; this includes removal of those peakers kept in service in the RNA Base Case due to their compliance plans, mainly in Zone K

RNA 70x30 Resource Adequacy Scenarios:

Generation Assumptions Common to Both Load Variations

- **Energy Storage**
  - MARS energy storage model, which allows for charging and discharging, and also includes temporal constraints (*e.g.*, hours/days or hours/month)
  - 8-hour storage resources will be modeled (similar to CARIS)
    - Note: at this time only 100% roundtrip efficiency can be modeled in MARS, which does not account for losses in charge/discharge cycle

Storage zonal distribution (similar to CARIS)

Zone	MW
A	150
B	90
C	120
D	180
E	120
F	240
G	100
H	100
I	100
J	1,320
K	480
NYCA	3,000

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RNA 70x30 High and Low Load Variations: Renewables Mix Assumptions

- **Renewables mix assumptions – similar to CARIS**
  - Land-based wind
    - Output shapes from CARIS (including curtailments)
    - 2009 National Renewable Energy Laboratory (NREL) data
  - Off-shore wind
    - Output shapes from CARIS (including curtailments)
    - 2009 NREL data
  - Utility-scale PV
    - Output shapes from CARIS (including curtailments)
    - 2017 DSS data used for existing plants, 2006 NREL data for new plants

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RNA 70x30 Scenarios: Renewable Mix by NYCA Zone

Renewable Resources Mix (Nameplate MW) for RNA 70x30 'Base Load Case' from CARIS)

Zone/Type	OSW	LBW	UPV	BTM-PV
A		2,286	4,432	995
B		314	505	298
C		2,411	2,765	836
D		1,762		76
E		2,000	1,747	901
F			3,592	1,131
G			2,032	961
H				89
I				130
J	4,320			950
K	1,778		77	1,176
Total	**6,098**	**8,772**	**15,150**	**7,542**

Zonal Renewable Mix (Nameplate MW) for RNA 70x30 'Scenario Load Case' from CARIS

Zone/Type	OSW	LBW	UPV	BTM-PV
A		1,640	3,162	995
B		207	361	298
C		1,765	1,972	836
D		1,383		76
E		1,482	1,247	901
F			2,563	1,131
G			1,450	961
H				89
I				130
J	4,320			950
K	1,778		77	1,176
Total	**6,098**	**6,477**	**10,832**	**7,542**

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Additional Fossil Removal Simulations

- Additional MARS simulations will be performed by removing the remaining fossil plants by age (from older to newer) until criterion violations observed

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2020 RNA 70x30 Scenarios: Transmission Security Assumptions

2020 RNA 70x30 Scenario: Transmission Security Assumptions

- Load will be modeled based on the 2020 Gold Book forecast for 2030 with adjustments for behind-the-meter solar
- Neighboring area interchanges are modeled at the values in the 2020 FERC 715 cases plus an HQ to Zone J 1,310 MW import consistent with the CARIS 70x30 scenario
- Additional fossil generation removals included in the resource adequacy assumptions are also used in the transmission security assumptions along with additional age-based removals
- The renewable resource additions will be modeled at the locations identified for the CARIS 70x30 Base Load case
  - Capacity values are treated as “Pmax” in the model
  - Other model parameters are developed for the model based on scaled values from the interconnection queue projects that were utilized in the CARIS assumptions, when available

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2020 RNA 70x30 Scenario: Transmission Security Assumptions

- Transmission security will assess under steady state various dispatches of renewable resources and different load levels

Case #	Case Load (Net Load including BtM solar reductions, MW)	Land-Based Wind (% of Pmax)	Off-Shore Wind (% of Pmax)	Solar (% of Pmax)
1	Day Peak Load (30,000)	10	20	45
2	Evening Peak Load (31,100)	0	0	0
3	Light Load (12,500 MW)	15	45	0
4	Light Load (12,500 MW)	0	0	0
5	Shoulder Load (21,500 MW)	0	0	40
6	Shoulder Load (21,500 MW)	15	45	40

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