**High Renewable Phase 2 Results Summary**

## Background

In 2019, the New York State Reliability Council (NYSRC) Installed Capacity Subcommittee (ICS) performed an analysis of potential Installed Reserve Margin ("IRM") and preliminary Locational Capacity Requirement ("LCR") impacts from hypothetical high penetration of intermittent renewable resources on the New York Control Area ("NYCA"). The analysis involved adding 4,000 MW of each on-shore wind, off-shore wind, and solar PV to the NYCA. The study and findings were documented in final *The Impacts of High Intermittent Renewable Resources*[1] whitepaper, and was considered as the Phase 1 study.

One of the recommendations in the Phase 1 study was to further examine the increased IRM and UCAP trends determined in that study. Accordingly, this Phase 2 study varied the penetration levels of the intermittent renewable resources assumed in the Phase 1 study, and without the limitations of transmission constraints[2]. This report summarizes the results from the Phase 2 study.

## Study Inputs

The Phase 2 study shares the same base case used in the Phase 1 study, which is the 2020 IRM Preliminary Base Case ("PBC"). The 2020 IRM PBC captures the constraints in the existing transmission system. It is expected that as the amount of renewable resource increases, the transmission constraints will become binding and that is reflected in the study results. In order to isolate the impacts of increasing renewable resources, the NYSRC also requested that the Phase 2 study to be conducted with transmission constraints removed from the simulation. Therefore, starting from the Phase 1 base case, transmission constraints are removed, and two scenarios with different levels of renewable resource penetration are modeled:

- Base Case = 2020 IRM PBC with transmission constraints removed
- Scenario A = Base Case + 2,000 MW of each renewable resource type
- Scenario B = Base Case + 6,000 MW of each renewable resource type

The modeling of the added renewable resources, including the renewable production profiles, locations of the renewable resources and modeled outage rates are consistent with Phase 1 study[3]. The detailed breakdowns of the added renewable resources for both Scenario A and Scenario B are shown in the two tables below. Table 1 includes the zonal ICAP breakdowns and Table 2 shows the associated zonal UCAP breakdowns, with the consideration of EFORds for the added renewable resources.

[1] Finalized whitepaper: https://www.nysrc.org/PDF/Reports/HR%20White%20Paper%20-%20Final%204-9-20.pdf
[2] Scope of Phase 2 study: https://www.nysrc.org/PDF/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20234/AI%208%20-%20High%20Renewable%20Supplemental%20Analysis.pdf
[3] Detailed assumptions of Phase 1 study: https://www.nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS%20Agenda%20223/AI%205'%20-%20windsolar-v04.pdf

***Table 1: Zonal Breakdown of Added Renewable Resources—ICAP Term***

| Zone | Scenario A: Base Case + 2,000 MW | | | | Scenario B: Base Case + 6,000 MW | | | |
|---|---|---|---|---|---|---|---|---|
| | Solar | On-Shore | Off-Shore | Total | Solar | On-Shore | Off-Shore | Total |
| A | 437 | 515 | | 952 | 1,311 | 1,545 | | 2,856 |
| B | | | | 0 | | | | 0 |
| C | 203 | 497 | | 700 | 609 | 1,491 | | 2,100 |
| D | | 447 | | 447 | | 1,341 | | 1,341 |
| E | | 541 | | 541 | | 1,623 | | 1,623 |
| F | 941 | | | 941 | 2,823 | | | 2,823 |
| G | 224 | | | 224 | 672 | | | 672 |
| J | | | 1,000 | 1,000 | | | 3,000 | 3,000 |
| K | 144 | | 1,000 | 1,144 | 432 | | 3,000 | 3,432 |
| Total | 2,000 | 2,000 | 2,000 | 6,000 | 6,000 | 6,000 | 6,000 | 18,000 |

***Table 2: Zonal Breakdown of Added Renewable Resources—UCAP Term (with EFORds)***

| Zone | Scenario A: Base Case + 2,000 MW | | | | Scenario B: Base Case + 6,000 MW | | | |
|---|---|---|---|---|---|---|---|---|
| | Solar | On-Shore | Off-Shore | Total | Solar | On-Shore | Off-Shore | Total |
| A | 137 | 79 | | 216 | 411 | 238 | | 649 |
| B | | | | 0 | | | | 0 |
| C | 64 | 77 | | 140 | 191 | 230 | | 421 |
| D | | 62 | | 62 | | 185 | | 185 |
| E | | 93 | | 93 | | 279 | | 279 |
| F | 263 | | | 263 | 788 | | | 788 |
| G | 62 | | | 62 | 185 | | | 185 |
| J | | | 294 | 294 | | | 882 | 882 |
| K | 57 | | 337 | 393 | 170 | | 1,010 | 1,179 |
| Total | 581 | 311 | 631 | 1,522 | 1,743 | 932 | 1,892 | 4,566 |

The breakdown of added renewable resources in each zone is in proportion to the renewable resource additions in the Phase 1 study.

**Study Results**

The two scenarios were developed based on the High Renewable Sensitivity from the Phase 1 study, which is the Tan45 case with the addition of 4,000 MW for each of the renewable resource types, and capturing transmission constraints. A parametric analysis was then performed by removing transmission constraints, and subsequently subtracting or adding incremental MW of renewable resources to arrive at Scenario A and Scenario B.

It is important to note that, by removing transmission constraints on the system, there are no longer trade-offs between Zone J/K and the rest of the system. In this case, the MW in Zone J or Zone K provide the same LOLE relief as the MW in the rest of the system. As a result, the determination of LCRs, which identify capacity requirements in the constrained Zones J and K, becomes impossible in the unconstrained simulation. Therefore, all the results in Phase 2 study are based on parametric comparisons. Even though

some statistics can be calculated for Zone J and K, similarly to the Phase 1 study, those statistics would not provide meaningful information. Hence, the parametric results of the installed reserve margin and the unforced capacity reserve margin ("URM") for the NYCA are reported and included in the Table 3, and the detailed ICAP and UCAP changes are included in Table 4 below.

***Table 3: Results Comparison***

| Cases and Scenarios | Phase 1 Tan45 Results | Phase 1 Adjusted Results | Phase 2 Scenario A | Phase 2 Scenario B |
|---|---|---|---|---|
| Each Renewable Resource Added | 4,000 MW (12,000 MW total) | 4,000 MW (12,000 MW total) | 2,000 MW (6,000 MW total) | 6,000 MW (18,000 MW total) |
| Transmission Constraints | Included | Removed | Removed | Removed |
| **Installed Capacity Reserve Margin Comparison** | | | | |
| **NYCA** | 142.9% | 140.8% | 128.1% | 154.4% |
| **Unforced Capacity Reserve Margin (URM) Comparison** | | | | |
| **NYCA** | 107.4% | 105.8% | 104.3% | 108.1% |

***Table 4: ICAP and UCAP Changes Comparison***

| NYCA | Phase 1 Tan45 Results | Phase 1 Adjusted Results | Phase 2 Scenario A | Phase 2 Scenario B |
|---|---|---|---|---|
| NYCA Peak Load (MW) | 32,253 | 32,253 | 32,253 | 32,253 |
| **ICAP Changes** | | | | |
| As Found ICAP (MW) | 54,465 | 54,465 | 48,465 | 60,465 |
| ICAP @ LOLE = 0.1 (MW) | 46,088 | 45,419 | 41,314 | 49,804 |
| ICAP Removed (MW) | 8,376 | 9,046 | 7,151 | 10,661 |
| ICAP Reserve Margin | 142.9% | 140.8% | 128.1% | 154.4% |
| **UCAP Changes** | | | | |
| As Found UCAP (MW) | 40,509 | 40,509 | 38,986 | 42,032 |
| UCAP @ LOLE = 0.1 (MW) | 34,651 | 34,135 | 33,652 | 34,871 |
| UCAP Removed (MW) | 5,857 | 6,374 | 5,334 | 7,161 |
| UCAP Reserve Margin (URM) | 107.4% | 105.8% | 104.3% | 108.1% |

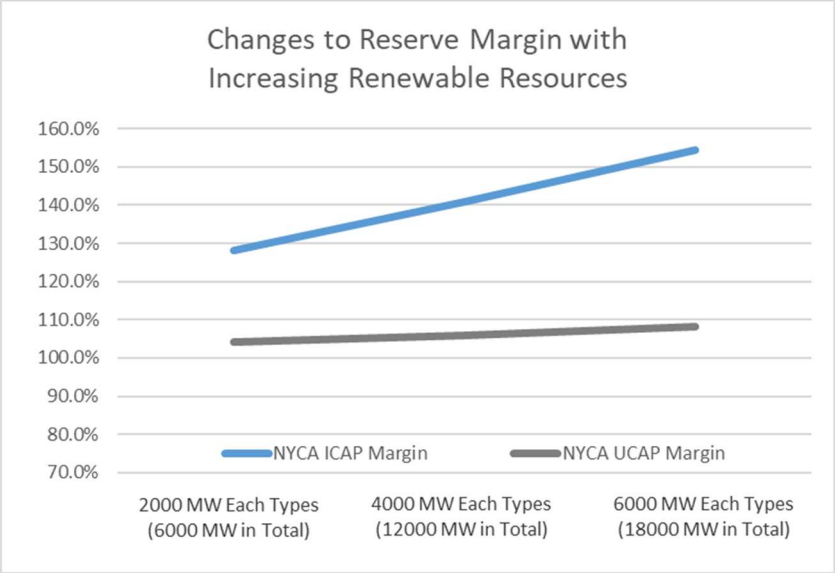
**Conclusion**

The Phase 1 whitepaper noted that the analysis is conducted with a hypothetical scenario. In reality, when the penetration of renewable resources reaches the similar level, other conditions on the system, including load, topology and other generations, also could have changed. The same caution should also be taken when interpreting the Phase 2 study results.

- In general, results from Phase 2 study are as expected. When removing transmission constraints, system requirement for resources is reduced, in both ICAP and UCAP terms.
- When increasing the penetration of renewable resources, the required ICAP, while maintaining the system LOLE at the 0.1 criterion, increases. This is largely driven by lower availability of intermittent resources compared to the average resources on the system.
- Similarly, the required UCAP for the NYCA also increases with higher penetration of renewable resources. As shown in Figure 1 below, the increases in required UCAP are at a lower level

compared against the required ICAP and appear to plateau at Scenario 2. Such result is expected as, with higher penetration, the value of incremental renewable resources is expected to diminish.

***Figure 1: Changes to Reserve Margin in ICAP and UCAP Terms***




## Recommendations

The results from the Phase 2 study support the conclusions and recommendations from the Phase 1 study. Therefore, there are no additional recommendations from the Phase 2 study.