Correlated Outage Impact on Resource Reliability Contribution

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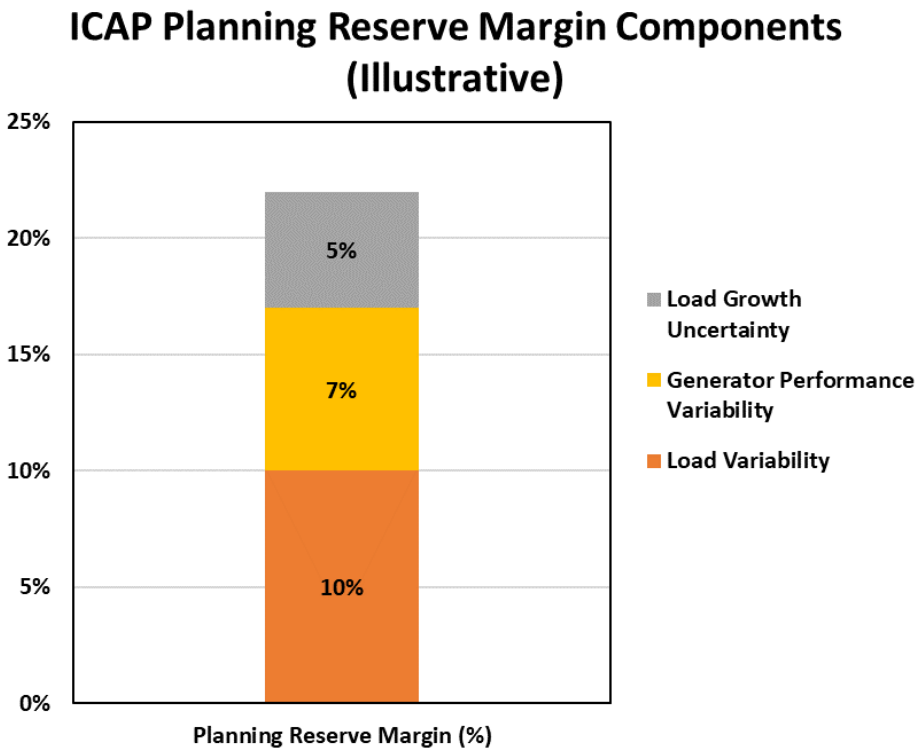
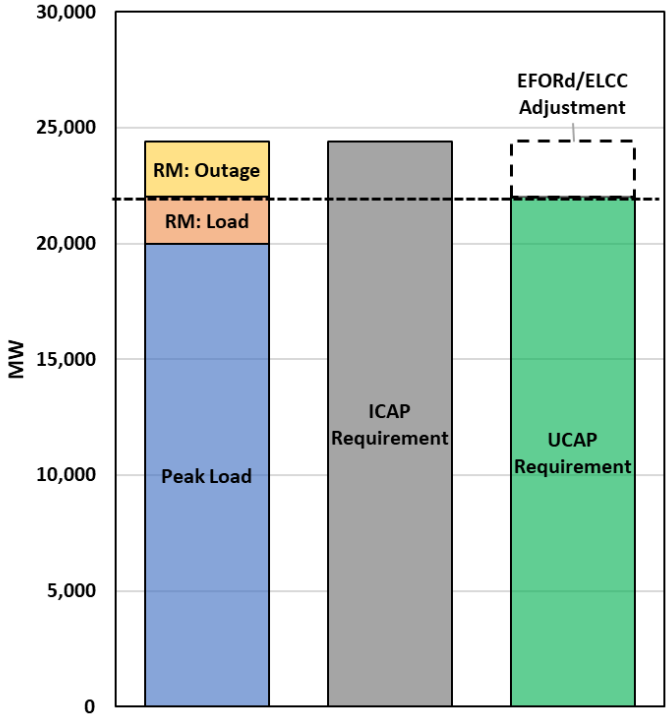
Resource Accreditation

- **Planning Reserve Margin (PRM) to maintain 0.1 LOLE based on three main uncertainty factors**
  - Load variability (weather/customer usage patterns)
  - Load growth uncertainty
  - Generator outage variability
- **Disconnect: Generator performance variability included in PRM while renewable variability addressed via ELCC analysis**



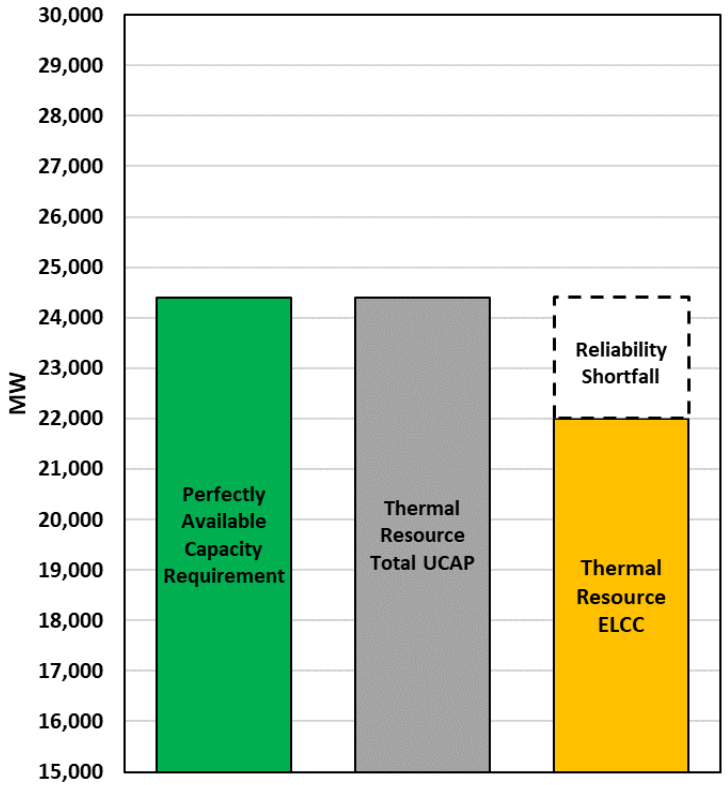
Resource Accreditation

- **Under a UCAP accreditation market, resource accreditation is converted to a perfectly available capacity equivalent value**
  - Thermal resources: UCAP = ICAP * (1-EFORd)
  - Renewable/energy limited resources: Effective Load Carrying Capability (ELCC)
- **In theory, when normalizing for perfectly available capacity, only load uncertainty drives the UCAP RM**



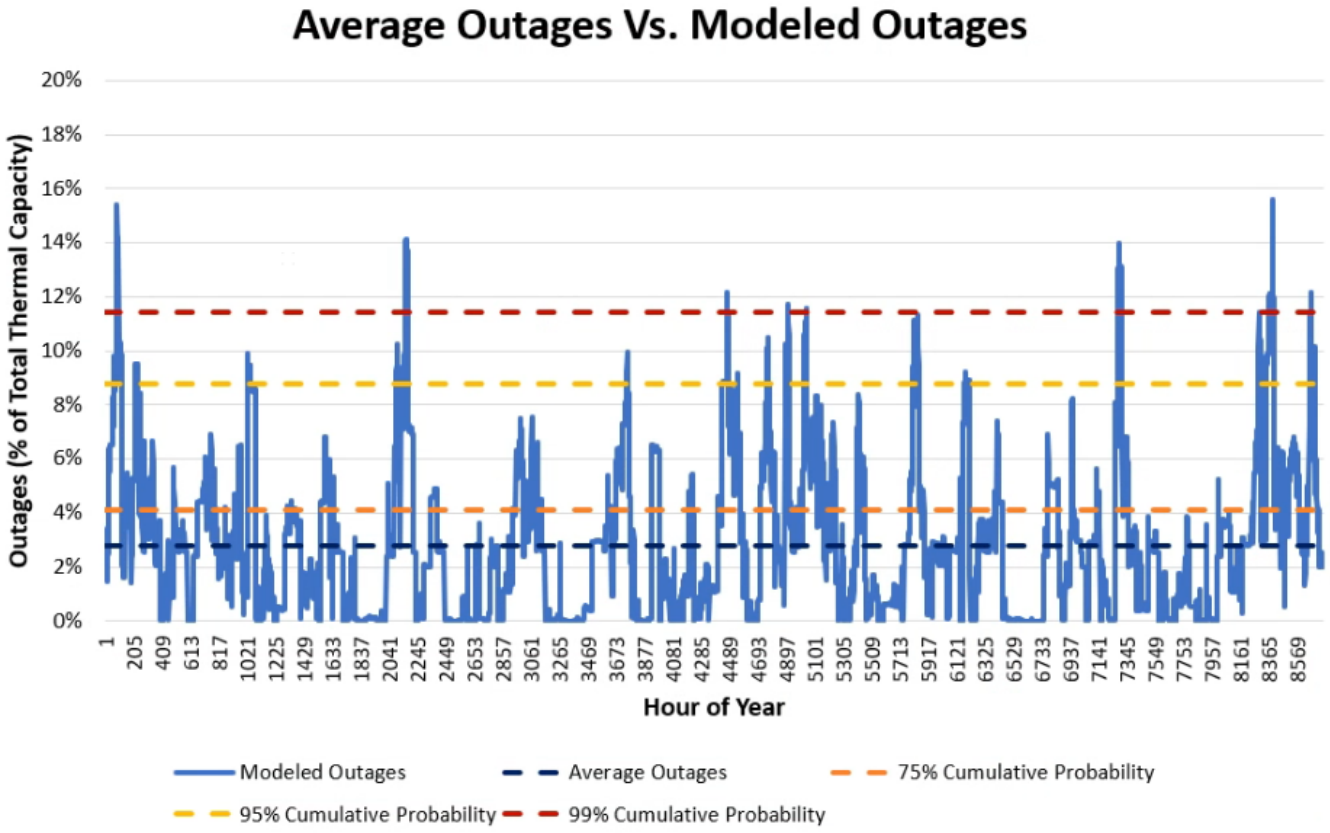
Resource Accreditation

- **However, UCAP accreditation may not be a good proxy for perfectly available capacity when accounting for fleet wide phenomenon of thermal resources**
- **Sum of all individual thermal resource UCAP values may be greater than the actual fleet wide contribution towards reliability (i.e., the thermal resource ELCC)**
  - May or may not affect PRM
- **Key fleet wide correlated outage categories include:**
  - Outage asymmetry
  - Common mode failures
  - Weather dependent outages
  - Fuel availability outages



Correlated Outage Impact #1: Outage Asymmetry

- **What level of reserves are needed to cover the impact of outages?**
  - UCAP accounting using EFORd presumes only average outages need to be addressed.



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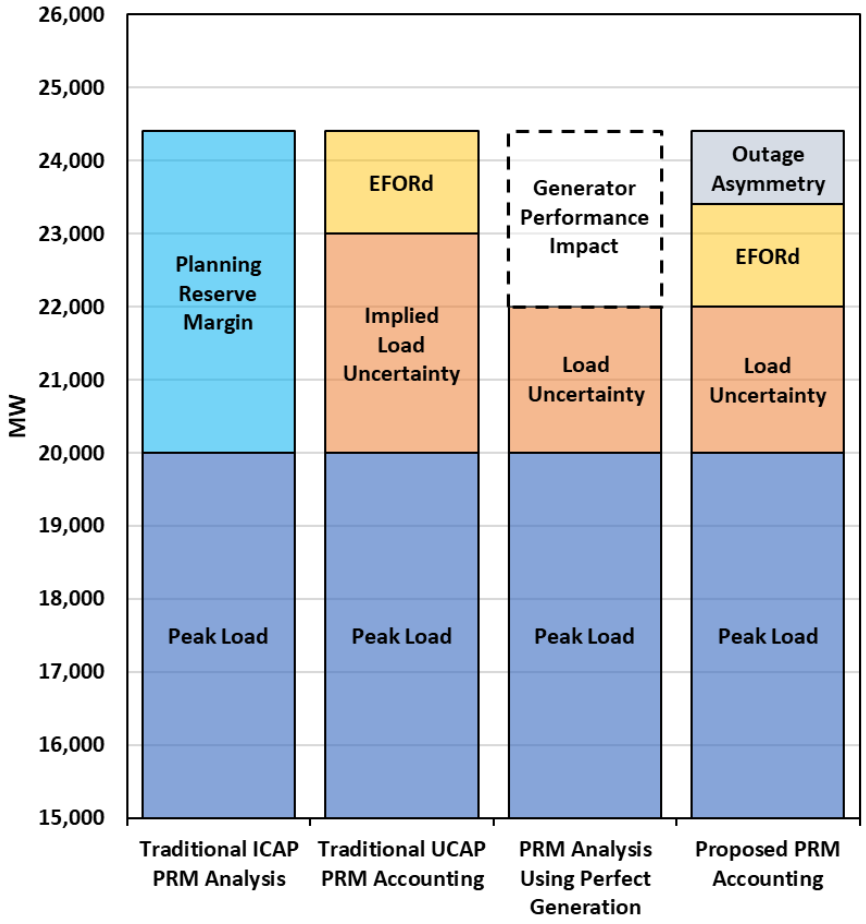
Correlated Outage Impact #1: Outage Asymmetry

- **Asymmetry is generally hidden in the PRM assessment.**
- **This issue would not be expected to affect PRM, only resource accreditation**



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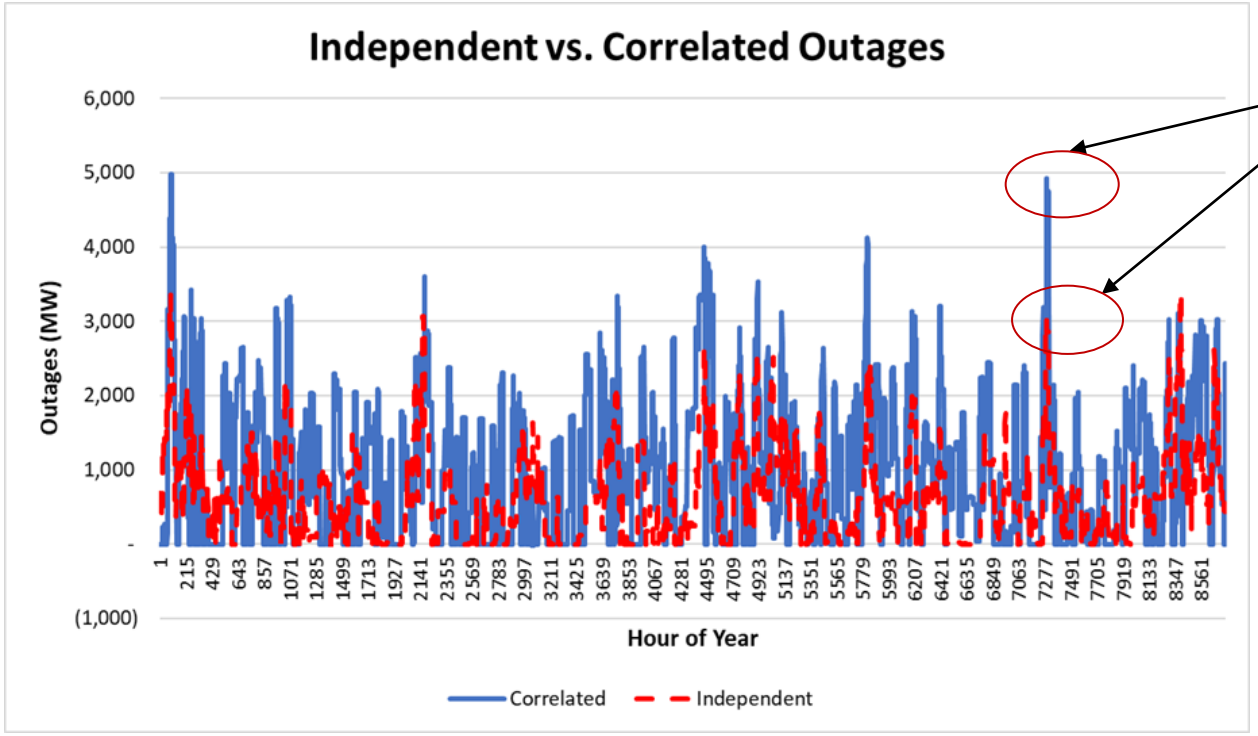
Proposed Solution for Outage Asymmetry

- **Accreditation of conventional resources could be adjusted to properly reflect their contribution to reliability**
  - E.g. Conventional Generator ELCC = (1 – EFORd – ADJ_{Asym})
- **Preliminary analysis suggests ADJ_{Asym} could be 2-5%.**
- **Similar adjustments proposed for other correlated outage effects.**

Correlated Outage Impact #2: Common Mode Failure

- **Most resource adequacy modeling randomly assigns availability status for each resource independently**
- **In reality, outages can be correlated between resources due to common mode failures (e.g. shared step up transformers)**



When applying correlated outages to RA modeling, higher cumulative outage events emerge

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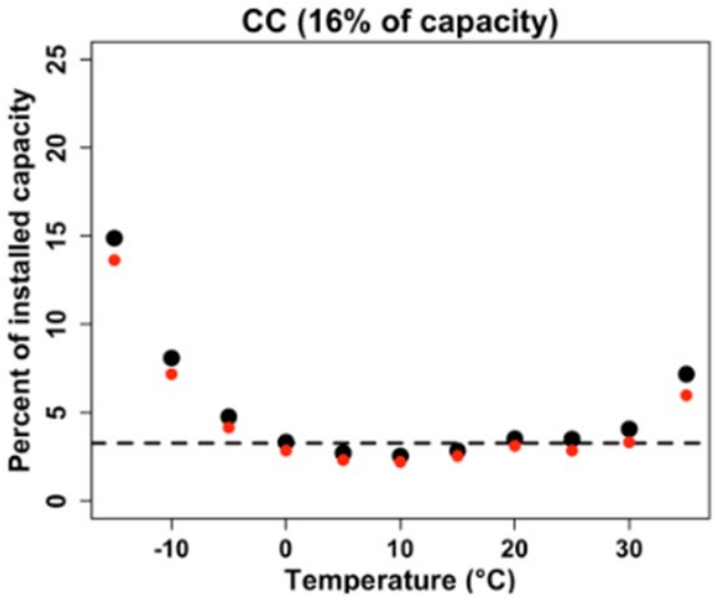
Correlated Outage Impact #3: Weather Dependent Outages

- **Additional correlated outage impacts observed in historical data based on weather impacts**
  - Cold weather events: frozen lines, frozen valves, critical sensor failures
  - Hot weather events: extended run times, heat stress on components
- **Example of historical PJM generator performance**
  - Combined cycle outage rate as a function of median (black series) and 90% temperature observation (red series)
  - At -10°C, CCs experienced ~4% higher forced outage rate than at 0°C



Source: Murphy, Sinnott, et. al. "A time-dependent model of generator failures and recoveries captures correlated events and quantifies temperature dependence."

Correlated Outage Impact #4: Fuel Availability Outages

- Natural gas supply constraints known to occur during cold weather
- As much as 10% of natural gas supply can become unavailable at temperatures of 0F (based on review of ERCOT 2021 event, 2014 Polar Vortex, 2011 FERC report on cold weather outages)
- Leads to an increase in cumulative outages for specific resource classes such as CTs and CCGTs

Modeling Results (Winter)

- **Impact of incremental outages quantified as percentage adjustment factors (ADJ) to approximate the thermal resource ELCC value**
  - $ELCC_{Thermal\,Resource} = (1 - EFORd\ - ADJ)$

Correlated Outage Category	Adjustment Factor (%)
Outage Asymmetry	2-5%
Common Mode Failure Outages	2-3%
Weather Dependent Outages	8-10%
Fuel Availability Outages	6-10%

Recommendations

- **Review historical data related to correlated outages within the NYISO region**
- **Explore modeling practices to account for correlated outages**
  - Requires definition of resource classes for thermal resources, analogous to renewable/storage ELCC calculations
  - Individual resource accreditation adjustments should be considered to appropriately distribute weather/fuel outage impacts in proportion to a unit's impact on the overall resource class ELCC

Questions?

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