Effective Load Carrying Capability at PJM

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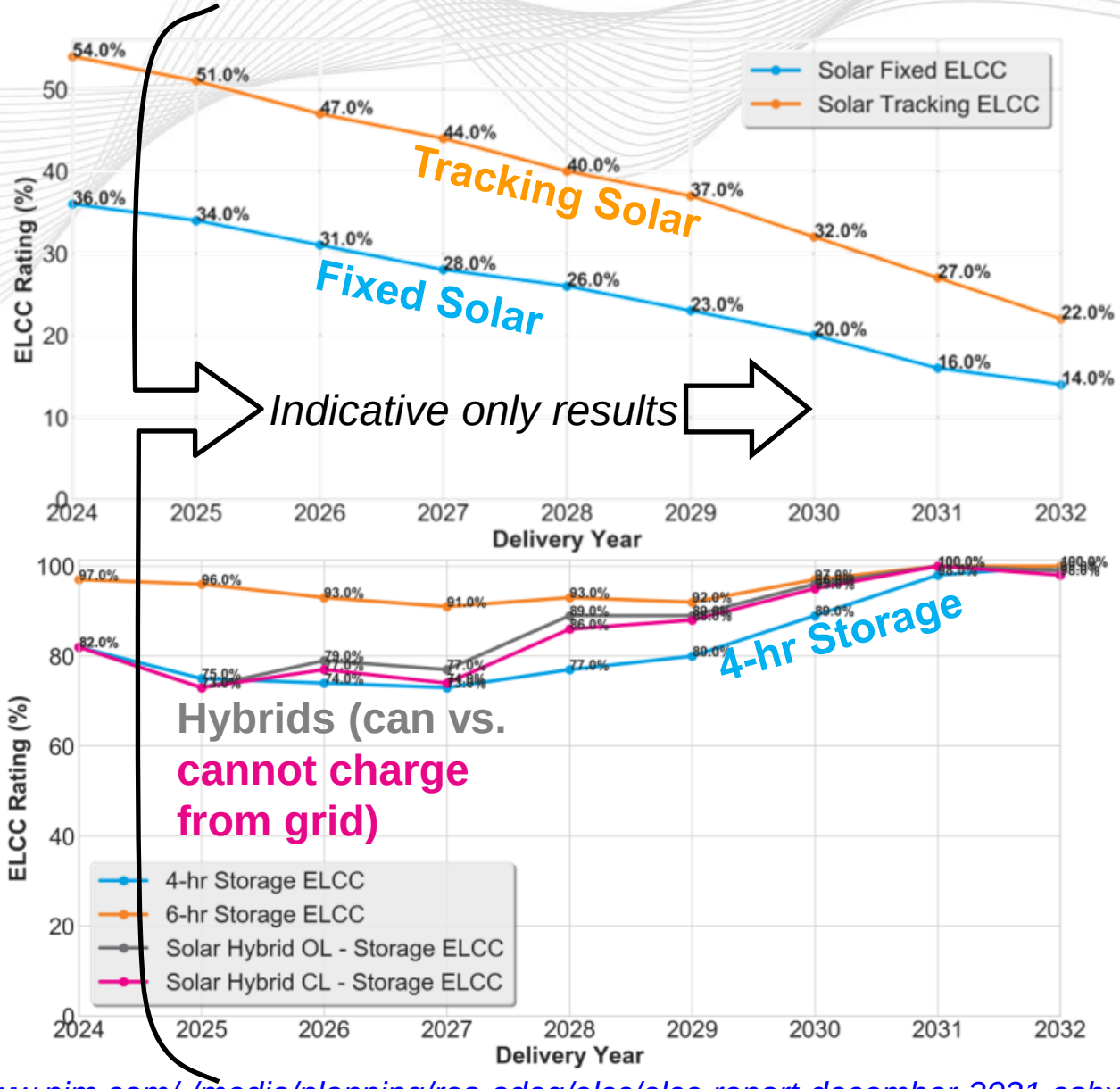
Basics of ELCC in PJM

- Effective Load Carrying Capability = ELCC.
- PJM use of that term is roughly:
  - "ELCC converts an hourly output profile into an equivalent resource adequacy value in more conventional terms. The calculation is based on loss of load expectation analysis."
  - PJM uses a "MW of perfect 24x7 gen equivalent" ELCC, rather than the stricter "MW of additional load" equivalent.

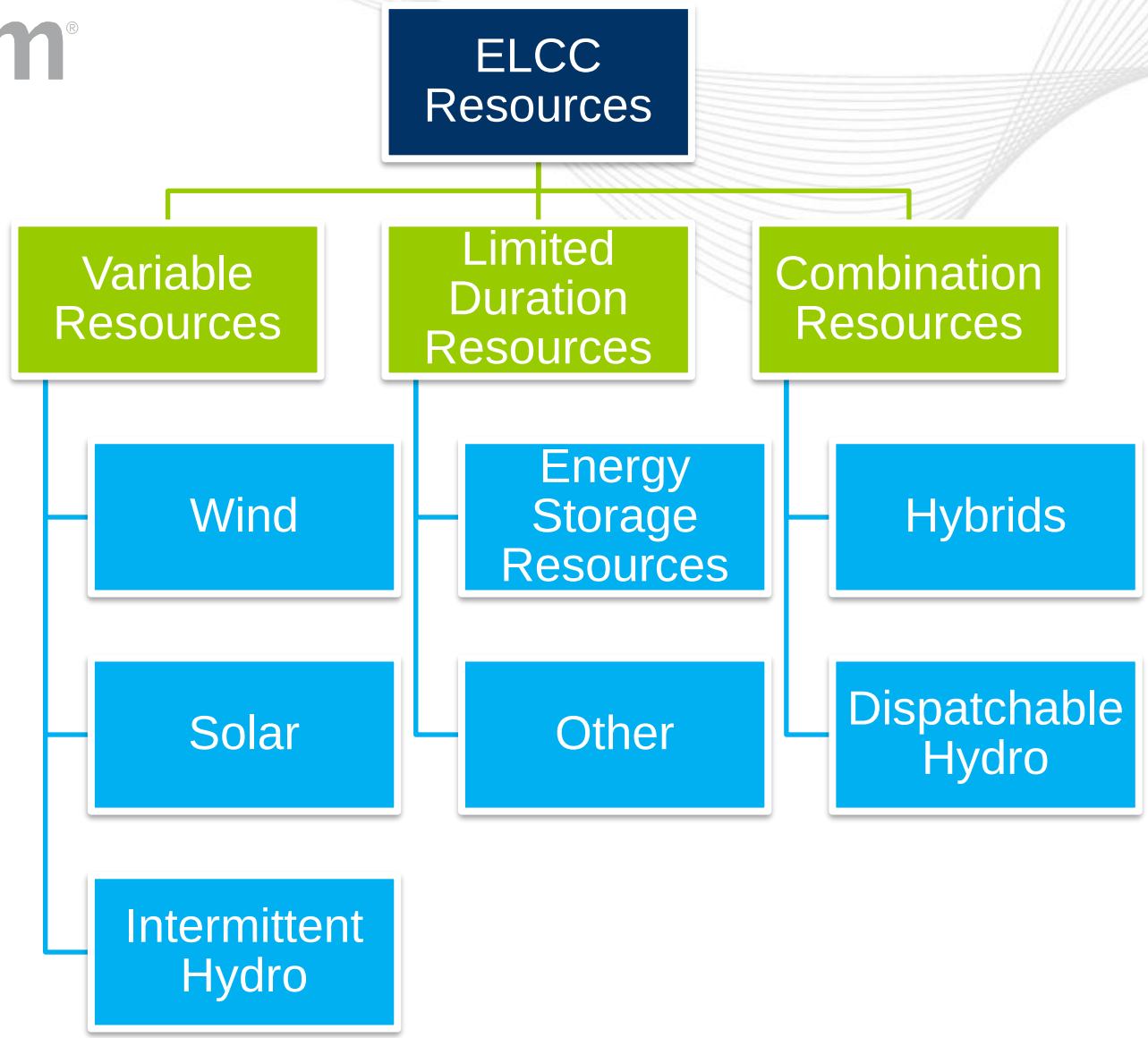
History and Applicability

- Before August 1, 2021, PJM did not use ELCC for anything.
- Starting August 1, 2021, PJM applies ELCC to all renewables and storage (with the exception of 24-hour-capable). ELCC starts with the 2023 Delivery Year (first auction for 2023 to be run later this year).
- Results for t+3y thru t+10y indicative only.
- Class-based approach includes, among others:
  - Onshore and offshore wind
  - Fixed and tracking solar
  - Dispatchable and intermittent hydro
  - Pumped hydro and batteries
  - Hybrids



https://www.pjm.com/-/media/planning/res-adeq/elcc/elcc-report-december-2021.ashx

Categories and Classes



- Variable Resources produce as high as they can (given wind/solar/water availability) almost all the time → historical output is evidence of energy availability.
- Other resource categories are assumed fully available up to max power all the time, and have output simulated based on physical limits.
  - *I.e., historical output is ignored.*
  - *Forced outages accounted for outside ELCC.*

Challenge 1: Granular But Simple Accreditation—Classes

- ELCC calculates a “Class Rating” for each class and each year. Multiplied by nameplate, this rating factor gives you the capacity value of the typical member of the class.
- Each unit then gets a unit-specific performance adjustment, which is close to 100%, and:
  - For Variable Resources, is the average of:
    - Output across the 200 coincident peak load hours of the last 10 years (adjusted for load forecast changes e.g. rooftop solar, potentially car charging, etc.)
    - Output across the 200 coincident peak net load hours of the last 10 years, where net load is load minus variable resource output of the future fleet in those hours (largely backcasted).
  - For Limited Duration Resources and dispatchable hydro, is 1-EFORd
  - For Combination Resources, is a combination of those methods.

Challenge 2: Developing Hourly Output Profiles

- Variable Resources: use historical output (mostly backcasted output, including some hydro, offshore wind).
- Energy Storage Resources:
  1. Simulate one gigantic storage resource.
  2. Start life at 0 MWh state of charge.
  3. Simulate charging during hours with plenty of excess margin. Stop charging when state of charge reaches max limit.
     A. In winter, storage can charge mid-day.
     B. There are some events in which charging is constrained by limited excess margin.
  4. Simulated discharging starts when load exceeds all thermal and Variable Resource capacity.
     - The different storage duration classes (4, 6, and 8 hour) share the discharge responsibility pro rata by total nameplate.
  5. In the hour that the margin of entire limited duration fleet (including dispatchable hydro) reaches the PJM target primary reserve level of around 2 GW, the model deploys demand response.
     - The storage fleet maintains 2 GW of non-deployed reserves until demand response runs out and reserves must be depleted to meet load.
- The storage component of a Combination Resource is dispatched like a standalone resource, except its hourly output cannot exceed available grid connection capability given the coupled Variable Resource output.

Challenge 3: The ELCC Model

- Model suite is rerun annually, with a 10-year look ahead.
- Uses load and weather data back to June 1, 2012.
- Each data year is replicated many times with different weather scenarios and forced outages.
- Hourly load shapes are modified according to load forecast, for example rooftop solar changes the shape (in future, could include car charging, etc).
- To complete each suite, the ELCC model is run several times for each class.
- PJM uses an “average-total” ELCC approach, as distinct from a “marginal ELCC” approach.
- Dispatchable hydro uses a unique mechanism to achieve a quasi-class-rating.

Thanks!

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