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CP Metrics for Wind and Solar Resources

PJM CIFP-RA Stage 2
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Outline

- Observations on some elements of the solutions matrix
- Additional options for measuring performance of solar and wind resources

CIFP-RA Matrix elements

Issue/Observation	KWA/Line
Support PJM's proposal to not rely on non-committed emergency imports • The capacity market should be pricing all supply and demand and should not build in reliance on a source that is not subject to the same obligations as internal resources.	2/9
Support adopting Expected Unserved Energy (EUE) as the metric	3/16
The trigger for Performance Assessment Intervals (PAI) should be transparent and objective • There should be no operator judgment involved, eg, declaration of an Emergency or pre-Emergency • For example, the depletion of Operating Reserves to a defined level would be a transparent and objective trigger	4/21

CIFP-RA Matrix elements

Issue/Observation	KWA/Line
Support having more assessment intervals • A flaw in CP is the rarity of PAIs, which makes PAI risk more singular and stochastic and harder to manage • More intervals is a good idea, but an arbitrary number is not • If depletion of Operating Reserves is the trigger for a 'Tier 1' PAI, the trigger for 'Tier 2' could be getting to within X MW of the Tier 1 trigger, for example	4/21
Expected Performance of Assessed Resources • This is the subject of the second part of this presentation	4/23
Excusals from Performance Shortfalls • Another way to think about what is 'expected' of Assessed Resources	4/26
• Support changing the basis for the stop-loss to revenue/BRA clearing price rather than Net CONE	4/29

CIFP-RA Matrix elements

Issue/Observation	KWA/Line
Capacity must-offer • There is nothing inherently wrong with requiring all potential capacity suppliers to offer *as long as they have flexibility to adequately reflect their individual assessments of costs and risks of taking on the obligation* • It is not appropriate to both require participation and to dictate price offers	9/56
Support recognizing opportunity costs of taking on a capacity commitment • This is basic economics; a potential seller of a product should include all costs associated with committing to the sale	9/62
Support expanding the language around Calculation of Capacity Performance Quantifiable Risk (CPQR) • Potential suppliers should be able to reflect all costs associated with the commitment • A standardized template is useful but cannot be used to limit other approaches or assessments of the extent of risk	9/63

Thesis

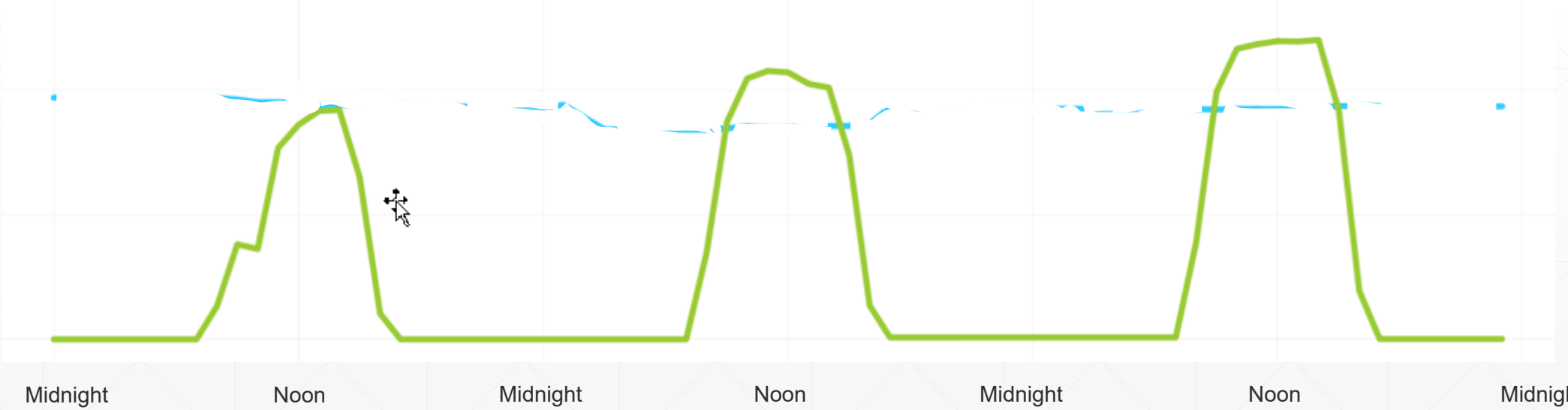
- The measurement of resource performance in Performance Assessment Intervals should reflect the operational characteristics that are known and accounted for in accreditation - not a simplified metric

Capacity Accreditation of Wind and Solar

- An ELCC/MRI approach to accreditation compares estimated energy production of profile resources to estimated demand across all hours of the year, to determine the reliability impact of the subject resource
- The reliability impact determined in this way is reduced to a single number to facilitate scalar tabulations of ‘resource adequacy’ and substitutability for planning and commercial purposes
  - This creates a fungible product across resource types that fully accounts for the operational characteristics of all resources
- However, the scalar accredited value is a derivative, not the actual contribution of the underlying resource to operational reliability

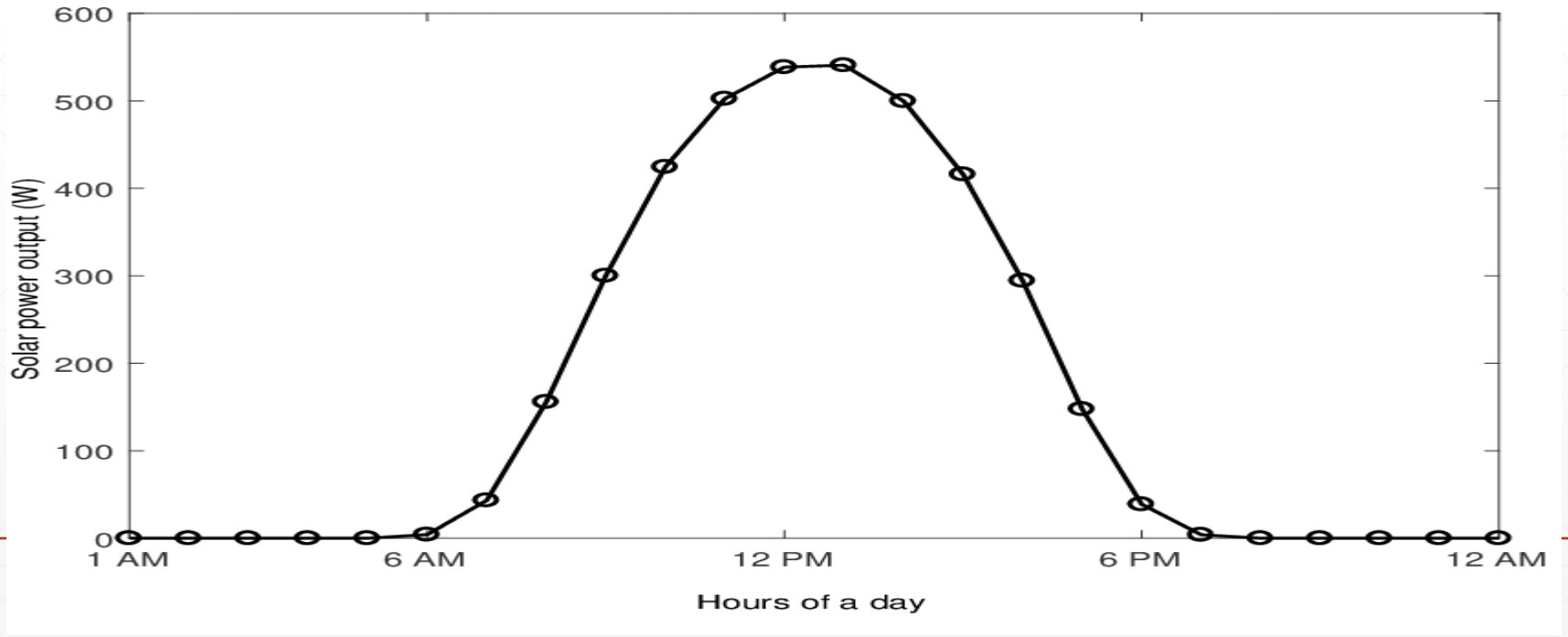
Accreditation and Obligations (1)

- Capacity accreditation is calculated based on hourly production profiles
  - (solar is used here as a conceptual example, but the concept applies more broadly)
- There is variation in the modeled profiles based on weather draws; this variability is understood and built into estimations of how these resources will line up with periods of operational stress on the system



Accreditation and Obligations (2)

- Daily energy offer obligations are based on a forecast of hourly production for the following day
  - (again, solar is used here as a conceptual example, but the concept applies more broadly)
- As we approach the operational timeframe, PJM works with a narrower range of deterministic outcomes, not averages



Accreditation and Obligations (3)

- Wind and solar resources are given a single accredited value as a means to facilitate resource adequacy planning and substitutability for commercial purposes, but that single value (whether annual, seasonal, or more granular) is inapplicable to the operational timeframe
- In day-ahead and real time operations, PJM expects a wind or solar resource to contribute energy production consistent with prevailing meteorological conditions (and subject to downward dispatch), as assumed in the original accreditation calculations
- Likewise, CP performance should be measured against the expected resource output consistent with prevailing meteorological conditions
- Actual energy production is almost certain to not match a static accredited value, and could be higher or lower

CP Measurement Baselines

- Measuring CP performance of profile resources against a static baseline introduces a number of concerns:
  - A static baseline is inconsistent with the assumptions in the accreditation calculations as well as day-ahead energy offer obligations
  - Actual production will be different from a static baseline in virtually every interval (could be higher or lower), leading to penalty charges or bonus payments under virtually any PAI, even if the resource is producing exactly consistent with its capabilities and prevailing meteorological conditions
    - Whether it's a penalty at midnight or a bonus payment at mid-day solar peak, such charges/payments bear no relationship to deviations from the basis of the resource's accreditation
  - Such bonus/penalty payments will create budgeting and cash flow challenges for wind and solar resource owners as well as other resource owners affected by the transfer of CP funds
  - With PAI events being extremely rare, there is limited opportunity for bonuses to offset losses over time

Suggested Baselines Consistent with Expectations (1)

- Conceptually, the CP performance baseline for profile resources should be based on expected production consistent with prevailing meterological conditions
- Option 1: Real Time Dynamic Baseline
- The most accurate baseline would be the calculated output of a fully available resource in real time based on observed wind speed, insolation, etc.
  - This approach could include 5-minute granularity
  - Any differences between actual production and calculated values would be penalized or rewarded, using the CP mechanism, as indicative of worse/better availability/efficiency/etc compared to design specifications
  - Weather risk is baked into the accreditation value and the resource owner bears equipment availability risk

RMI presented similar concepts to the RASTF on 10/11/22, https://www.pjm.com/-/media/committees-groups/task-forces/rastf/2022/20221011/item-02a---perspectives-on-high-level-design-concepts---rmi.ashx

Suggested Baselines Consistent with Expectations (2)

- Option 2: Day Ahead Forecast Baseline
- Day ahead market schedules for solar and wind resources are based on forecasts of energy production
- CP performance measurement could compare actual production during PAI events to the applicable day ahead forecast
  - Differences would reflect forecast error as well as availability/efficiency changes and would have hourly granularity, so would likely be less accurate than a dynamic approach
  - Likely less computationally complex than a real time dynamic approach
  - Resource owners bear equipment availability risk and some degree of weather risk as well as deviations within an hour

Suggested Baselines Consistent with Expectations (3)

- Option 3: Recognize Certainties in Profiles
- In the vast assortment of *uncertainties* that go into modeling capacity accreditation for all resources, there is *one absolute certainty*: solar production will be zero in hours with no sun and these hours are highly predictable each day
- This *certainty* is qualitatively different from an outage of a thermal plant or other probabilistic event and should be recognized in assessing performance
- CP performance for solar resources should be based on an expectation of zero output in non-solar hours even if the performance baseline in solar hours is a static monthly or seasonal value. This could be built into 'Expected Performance' or treated as an excusal, consistent with Planned and Maintenance Outages

Proposed Matrix Options

- KWA4, Matrix Row 23, Expected Performance Level of Assessed Resources
- Option 1 Real Time/Dynamic Baseline: “Expected performance level of wind and solar resources is equal to the maximum potential output of the resource given applicable prevailing real-time meteorological conditions.”
- Option 2 Day Ahead Forecast Baseline: “Expected performance level of wind and solar resources is equal to the forecast hourly output used by PJM in scheduling and clearing the Day Ahead market.”
- Option 3 Solar Certainty: “Expected performance level of solar resources is equal to zero in all hours each day from the hour containing sunset to the hour containing sunrise.”

Conclusion

- The operational reliability impact (aka ‘capacity’) provided by a profile resource is the underlying hourly production profile used to derive the accreditation quantity, not the single accreditation value
- Either of the RT or DA baselines suggested here for measuring CP performance (Options 1 and 2) would be more consistent with the underlying expectations and obligations of solar and wind resources
- Using a static performance baseline, even on a seasonal or monthly basis, will under- or over-state expected production in virtually every time interval and lead to arbitrary transfers of penalty/bonus funds whenever PAI events occur
- If a static baseline is used it should account for the certainty inherent in the solar profile (Option 3)

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