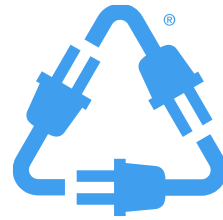


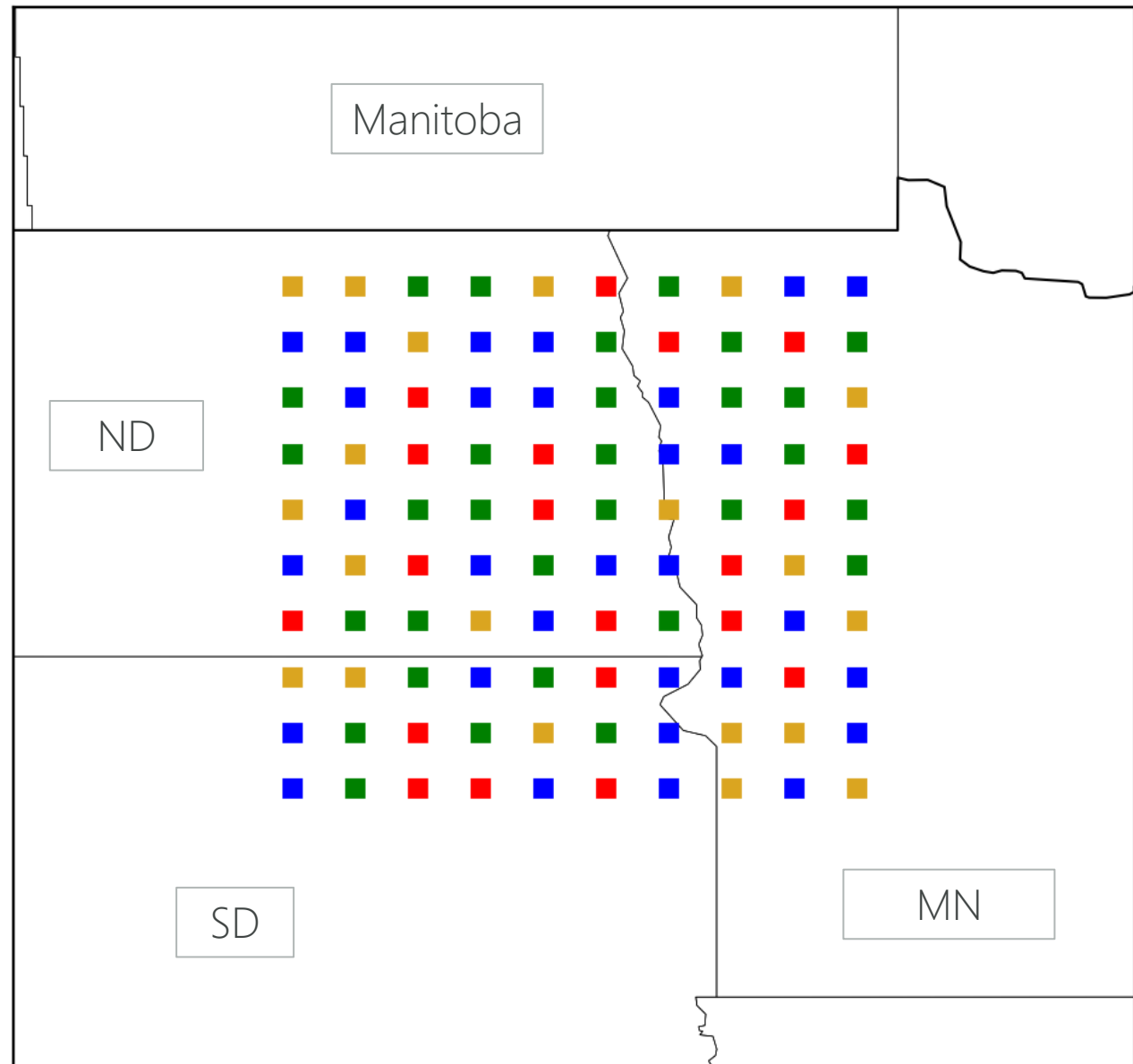
Probabilistic PV Forecasts: Fleet Ramp Rates and Minimizing Asymmetric Costs

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Clean Power Research
thaley@cleanpower.com

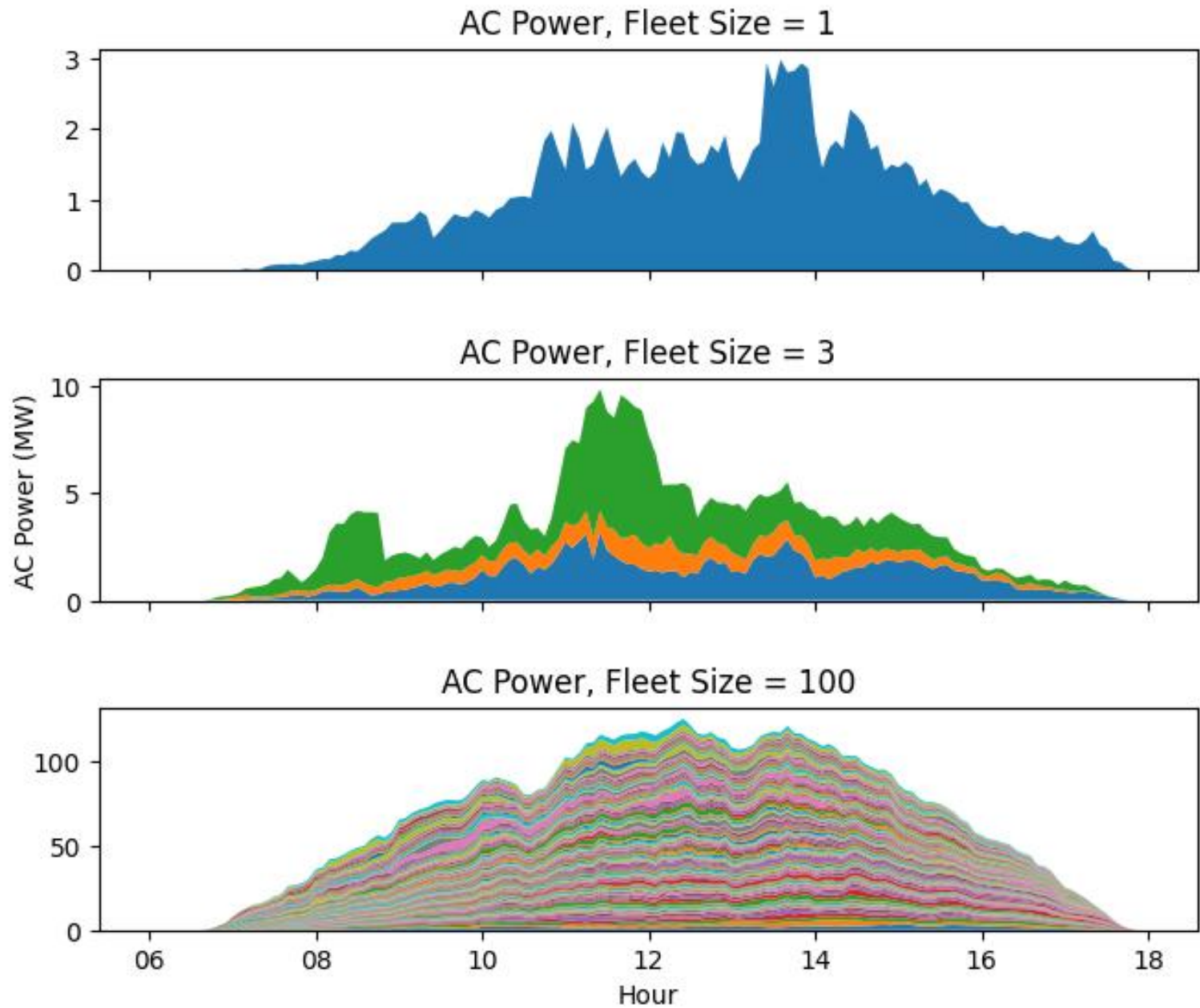


PV Fleet Model

- Horizontal
- South Facing
- East Facing
- West Facing



Creating a Fleet Power History

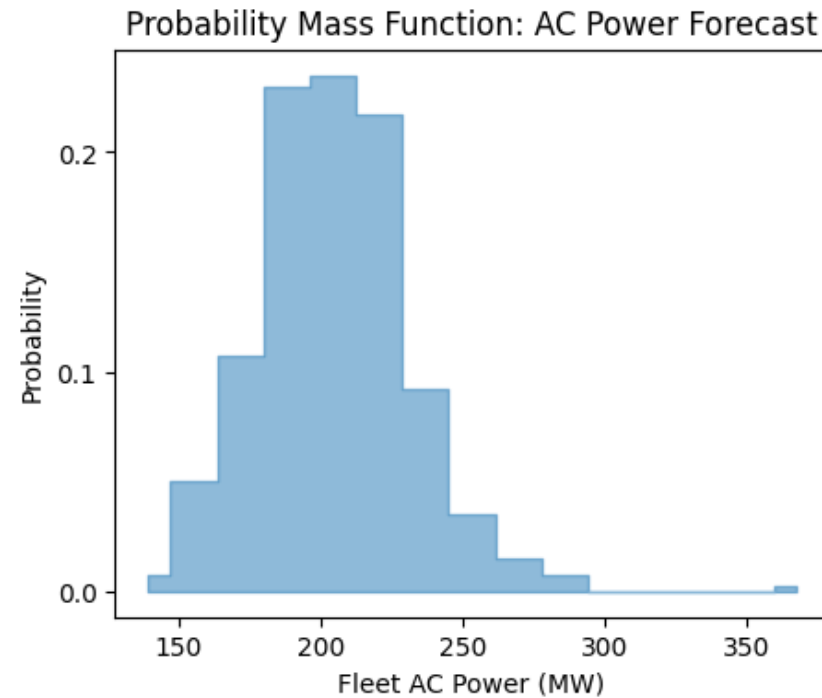


Deterministic Vs. Probabilistic Forecasts

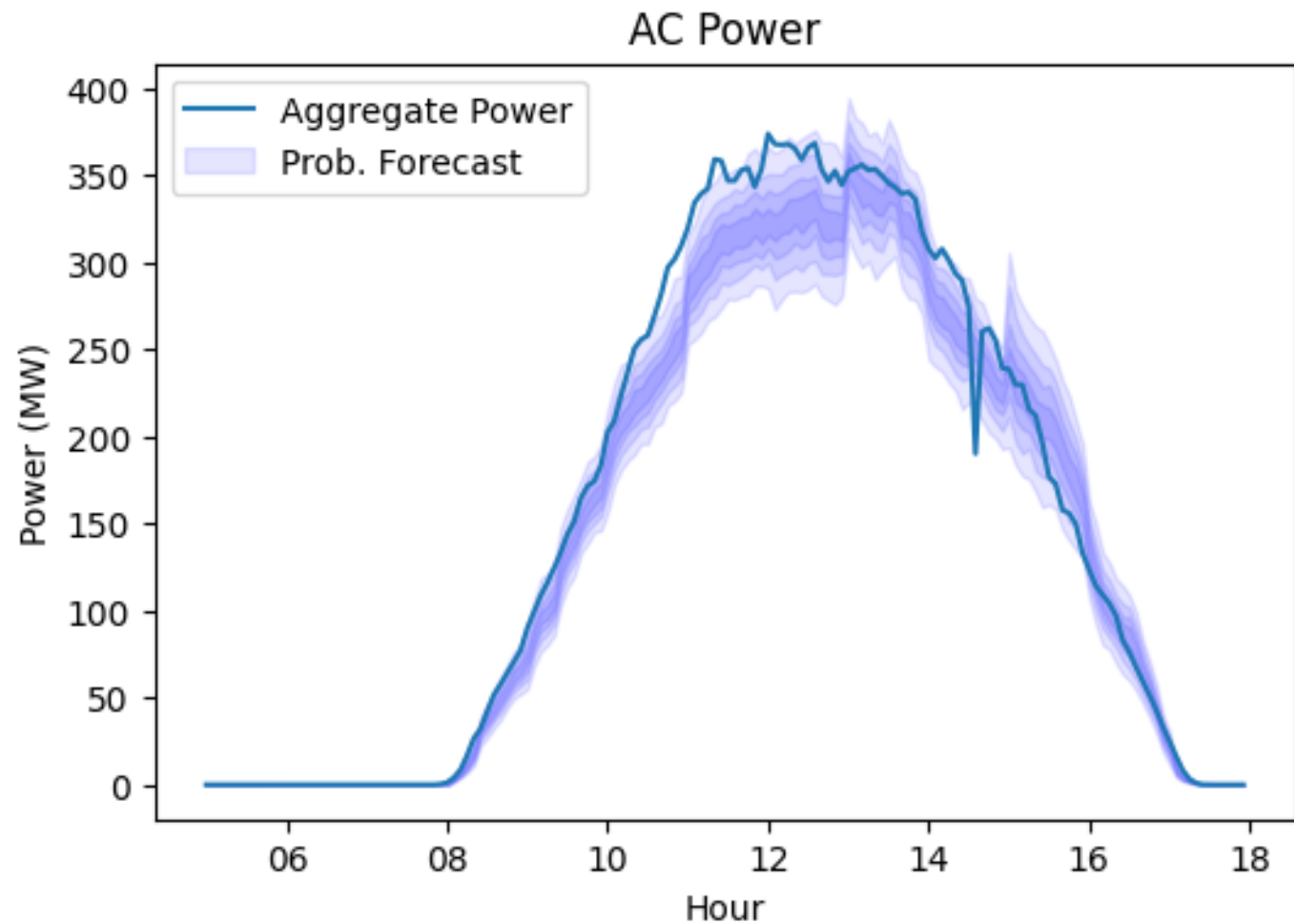
Deterministic

AC power = 201.4 MW

Probabilistic

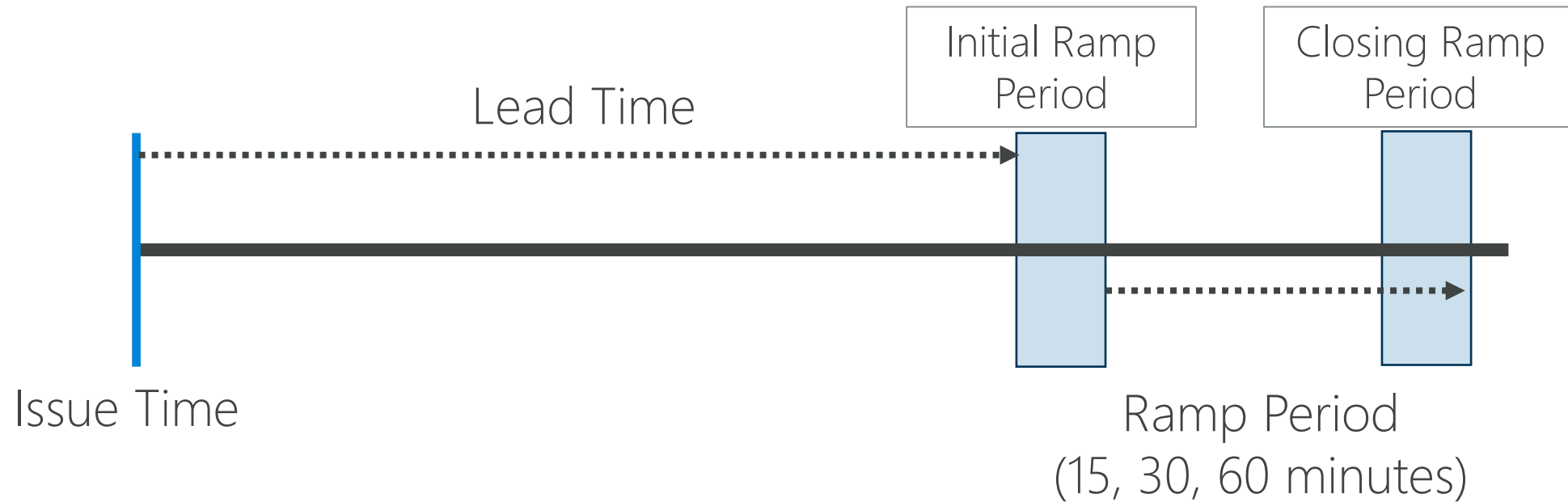


Fleet Aggregate Forecast



Probabilistic Ramp Rate Forecast

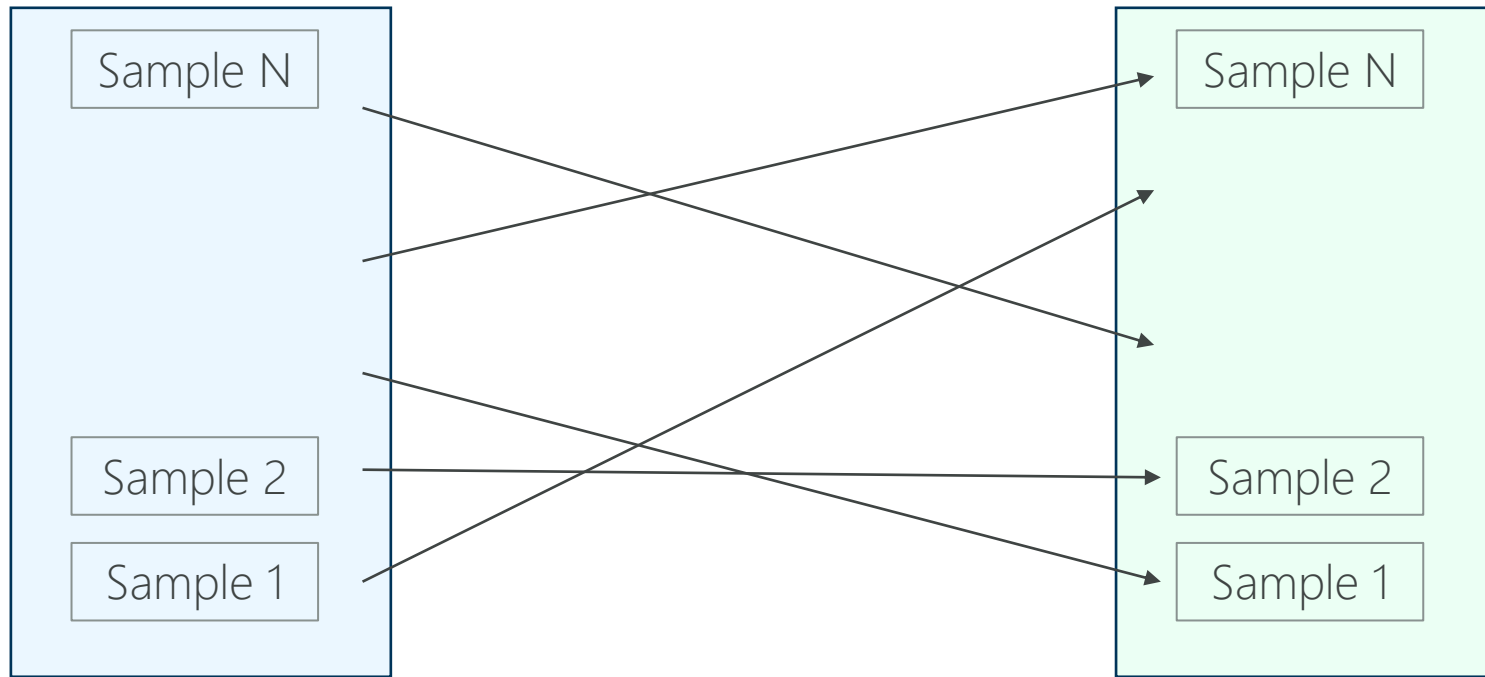
Ramp Rate Forecasts



Ramp Forecast Sampling: Unranked Sampling

Initial Ramp Period

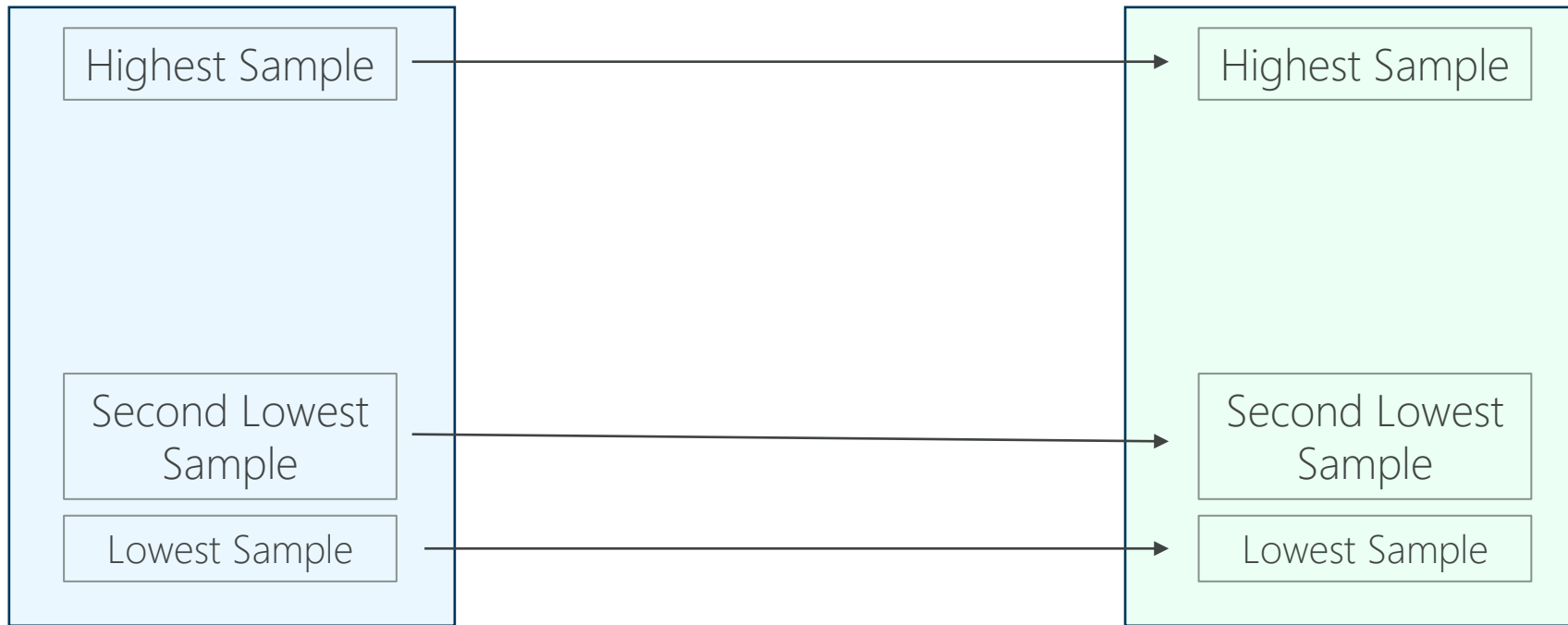
Closing Ramp Period



Ramp Forecast Sampling: Ranked Sampling

Initial Ramp Period

Closing Ramp Period



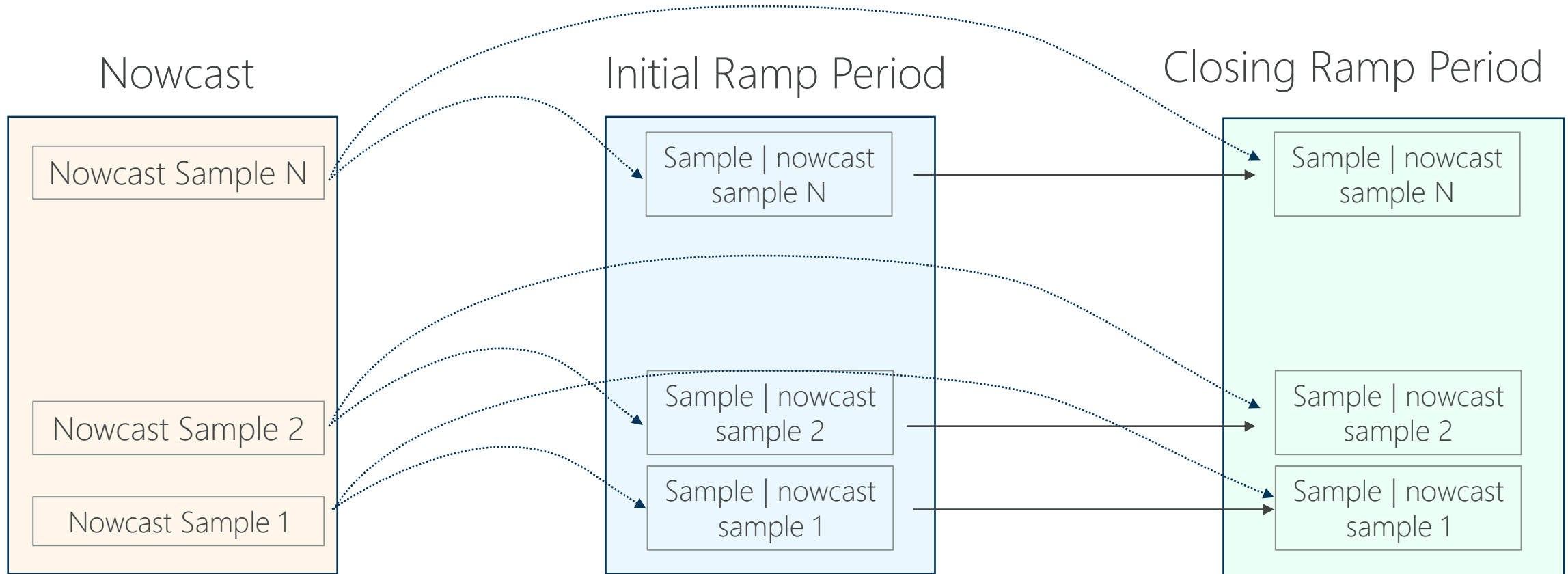
Conditional Forecasts

The “nowcast” forecast predicts the spread of fleet power at the first forecast period given the NWP inputs.

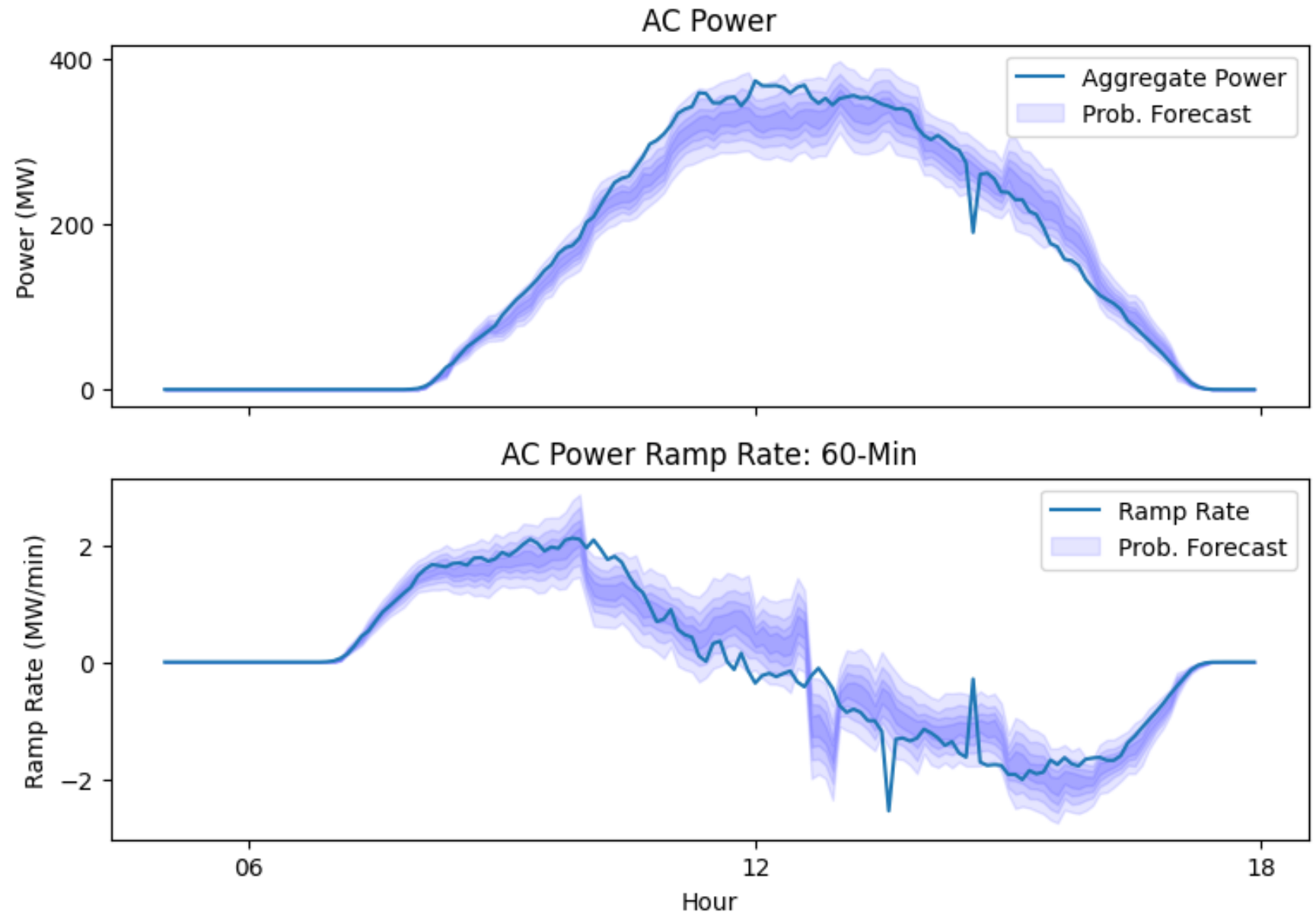
The “conditional” forecast predicts the spread of fleet power given the initial sample, and the NWP inputs.

The differences between each set of forecasts conditioned on the same “nowcast” sample create the set of ramp rate samples.

Ramp Forecast Sampling: Conditional Forecast Sampling

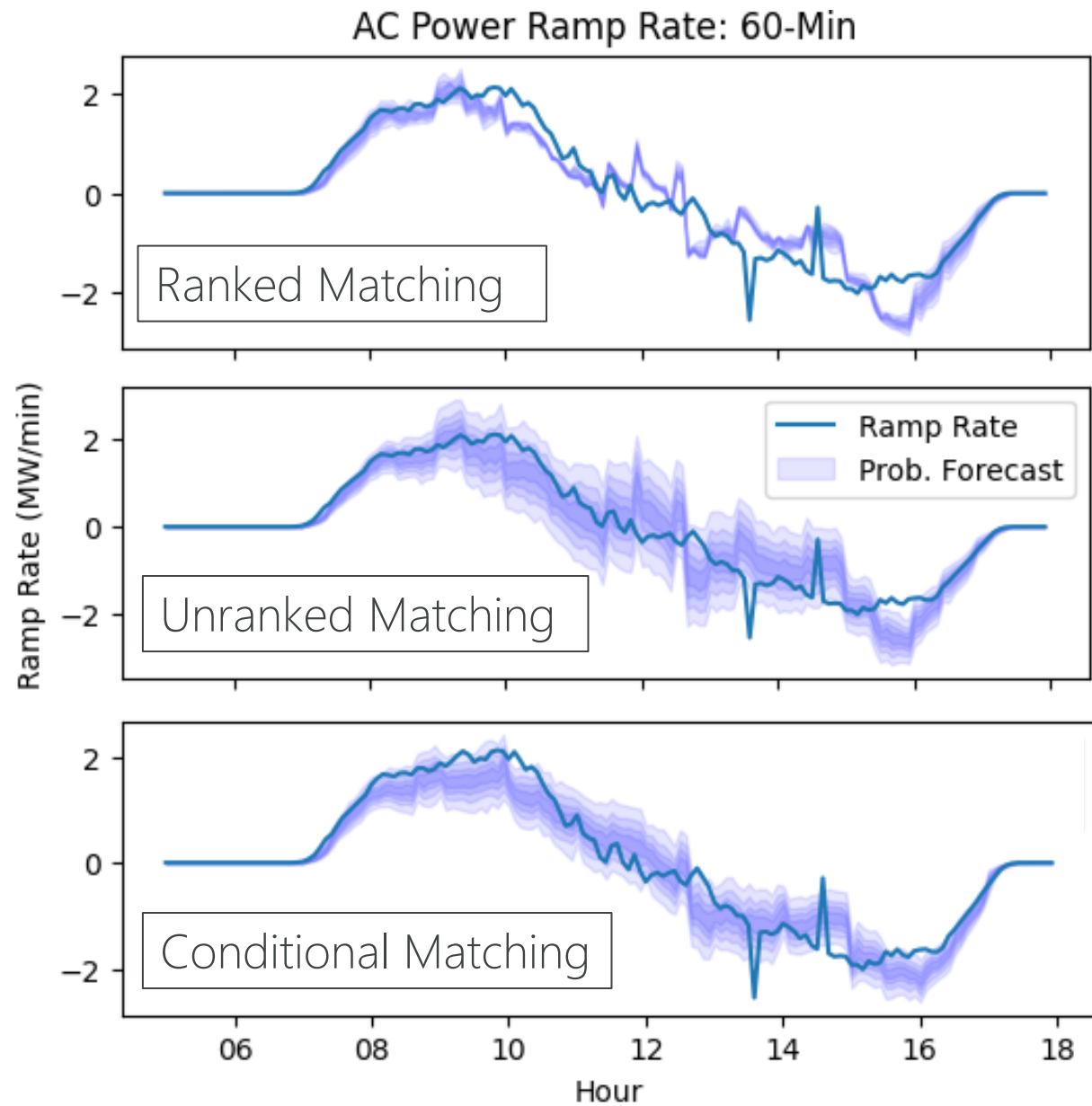


Probabilistic Ramp Rate Forecast

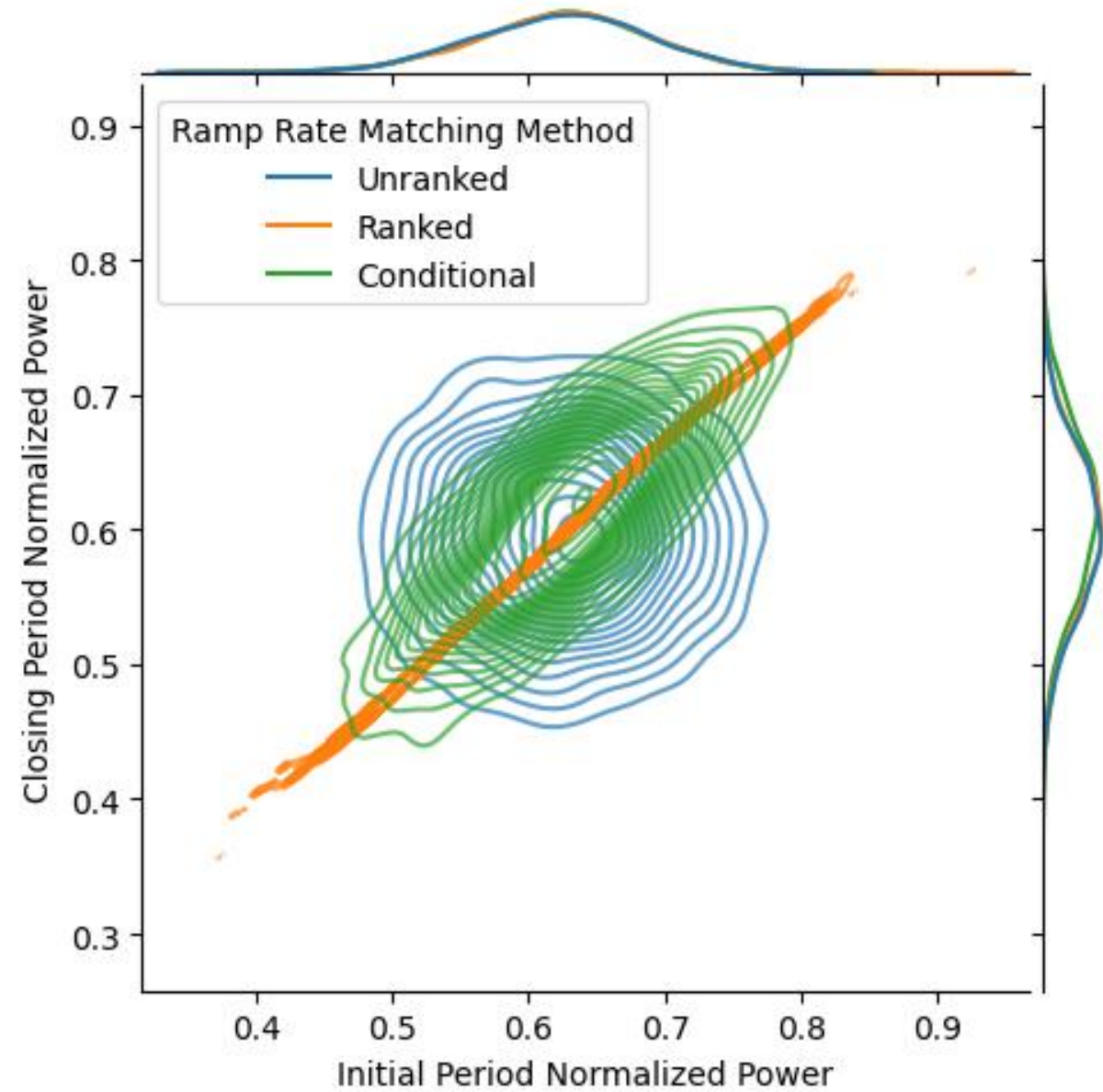


Sample Matching Method Comparison

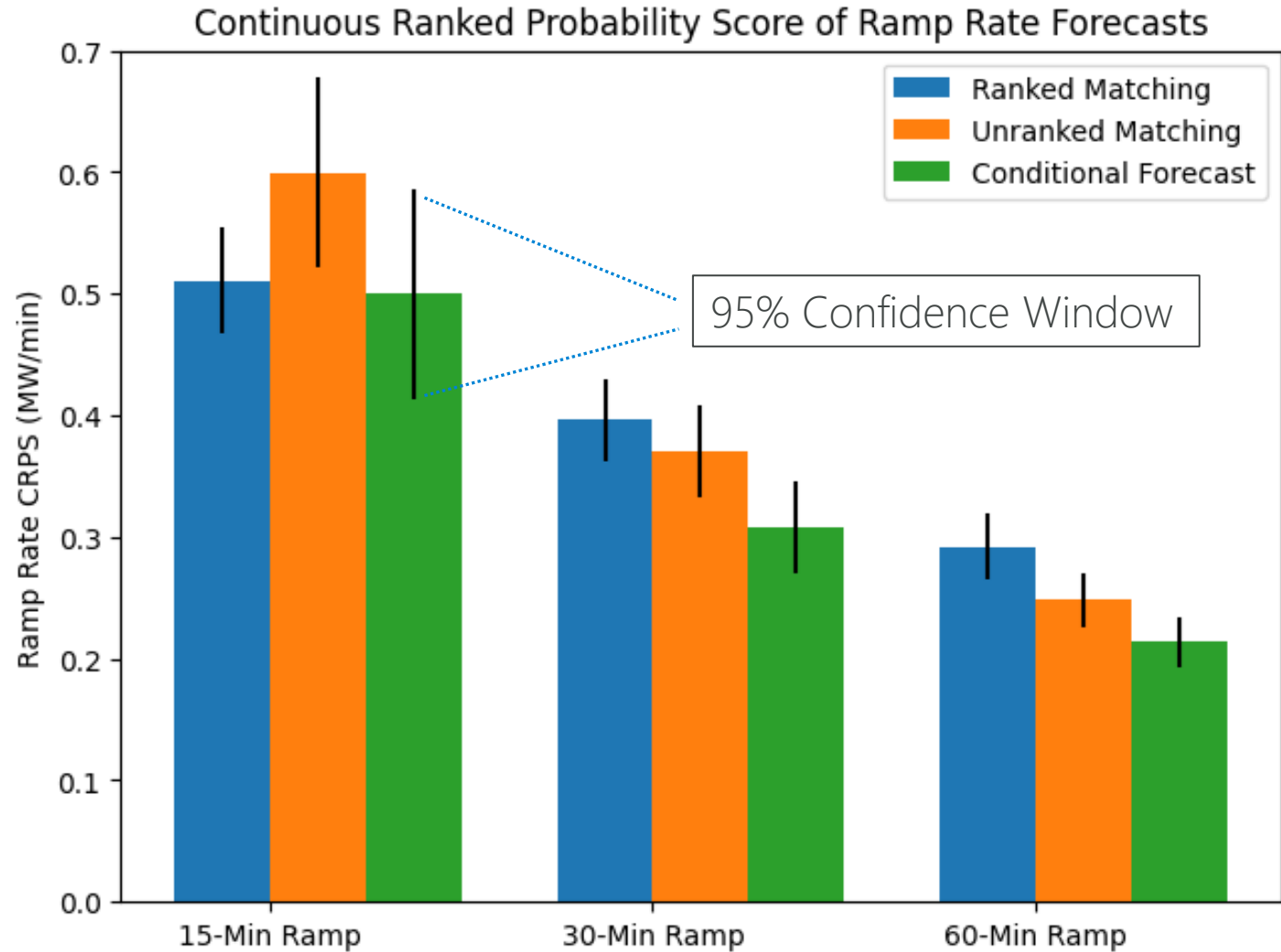
Ramp Rate Matching Method Comparison: Time Series



Ramp Rate Matching Method Comparison: Joint Distributions

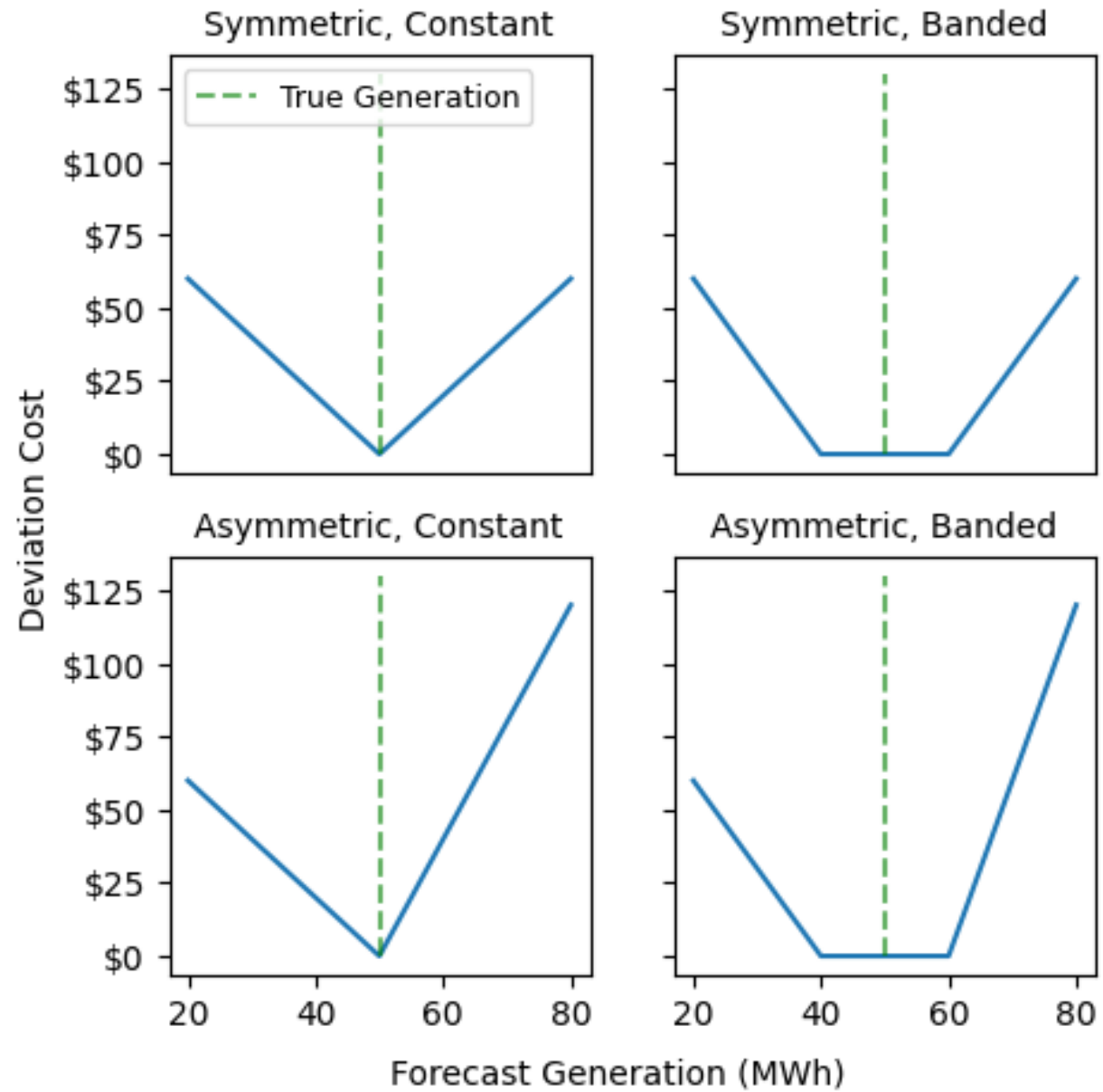


Cross-Validated Continuous Ranked Probability Scores

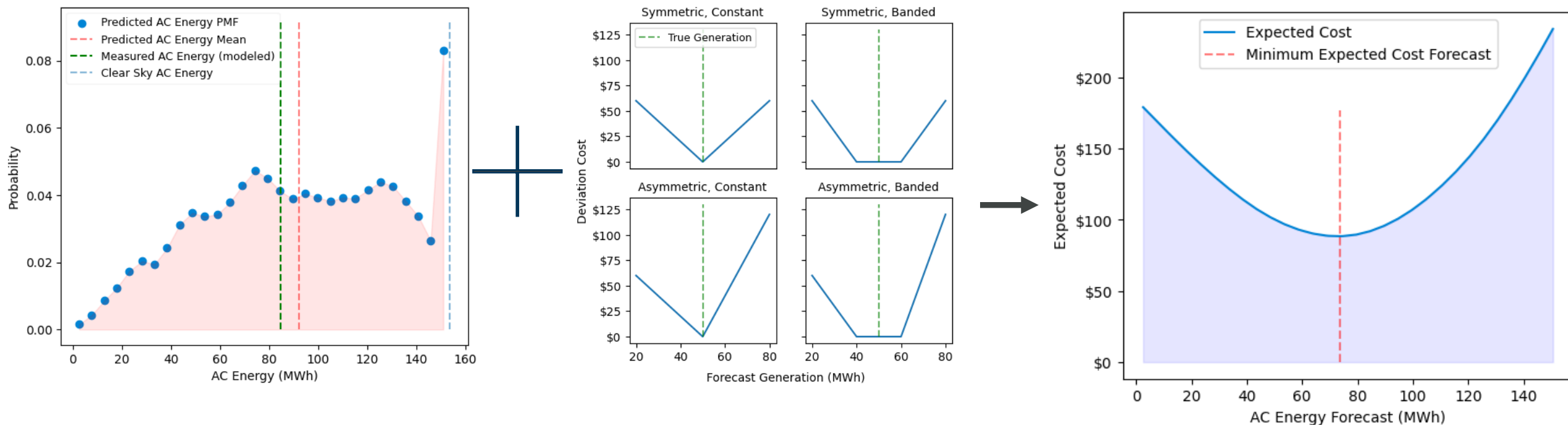


Minimizing Expected Cost

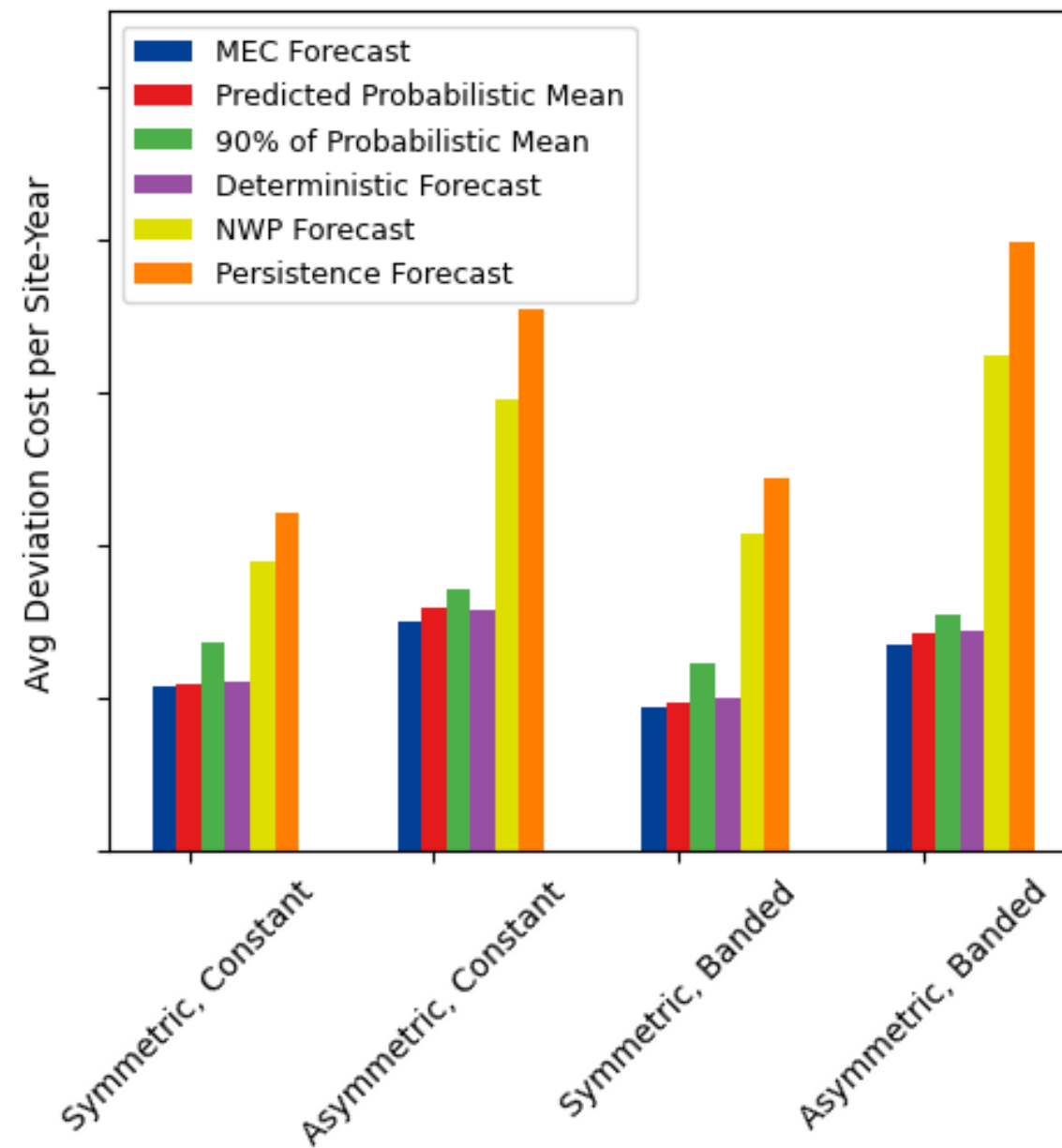
Diverse Cost Functions



Minimizing Expected Costs

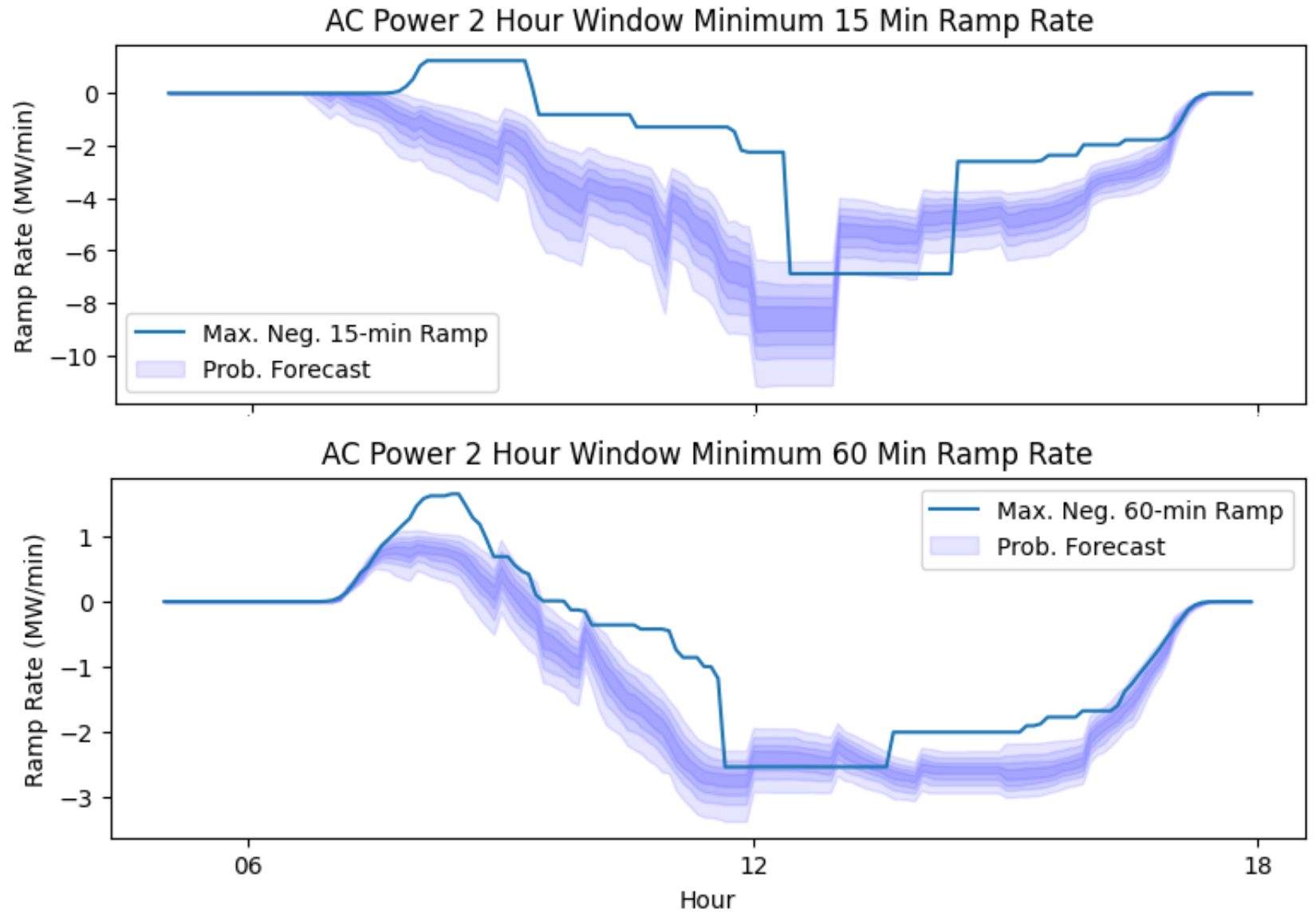


Diverse Cost Functions



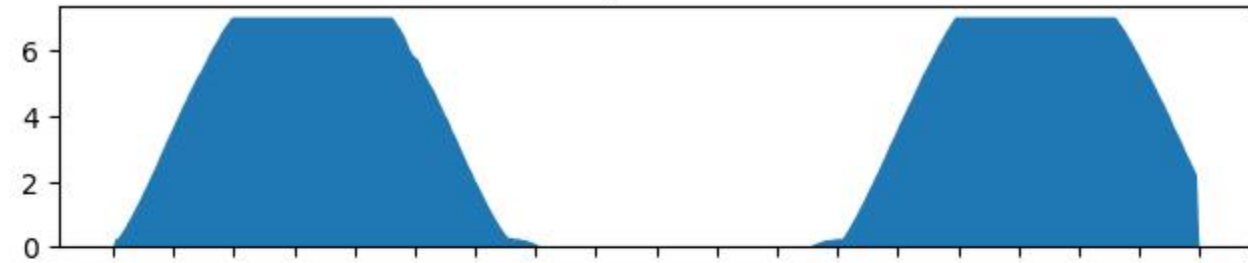
Extensions

Reserve Planning:
Forecast of
maximum negative
ramp rate over a
time window.

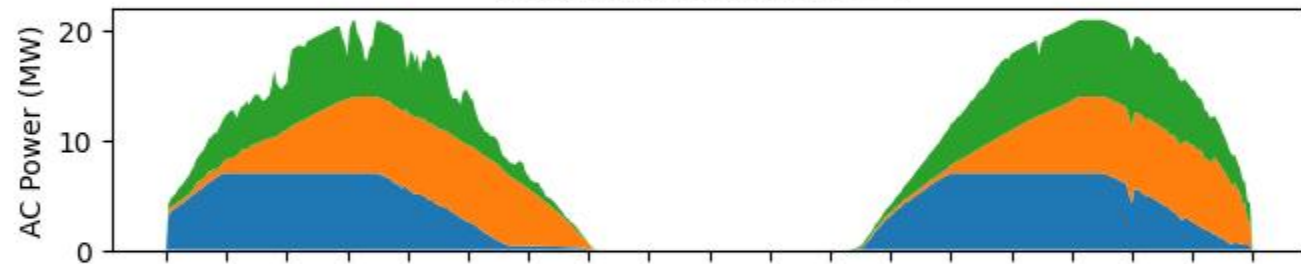


Forecasts Accounting for Derated Fleet Members

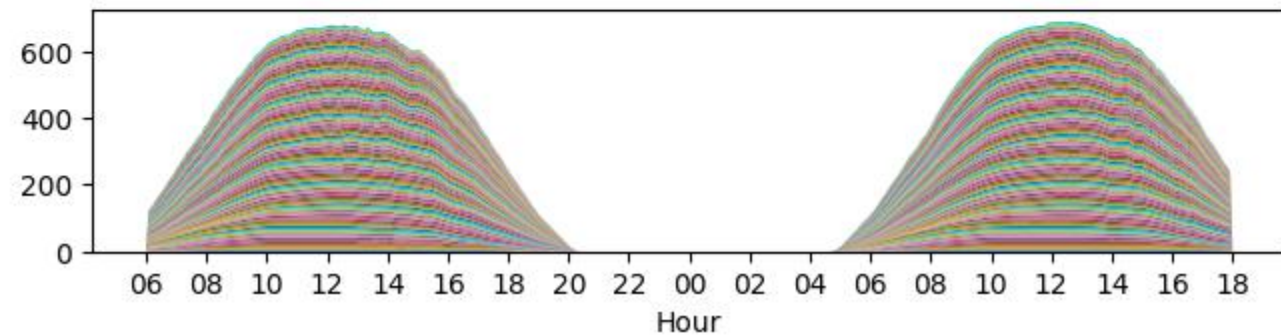
AC Power, Fleet Size = 1



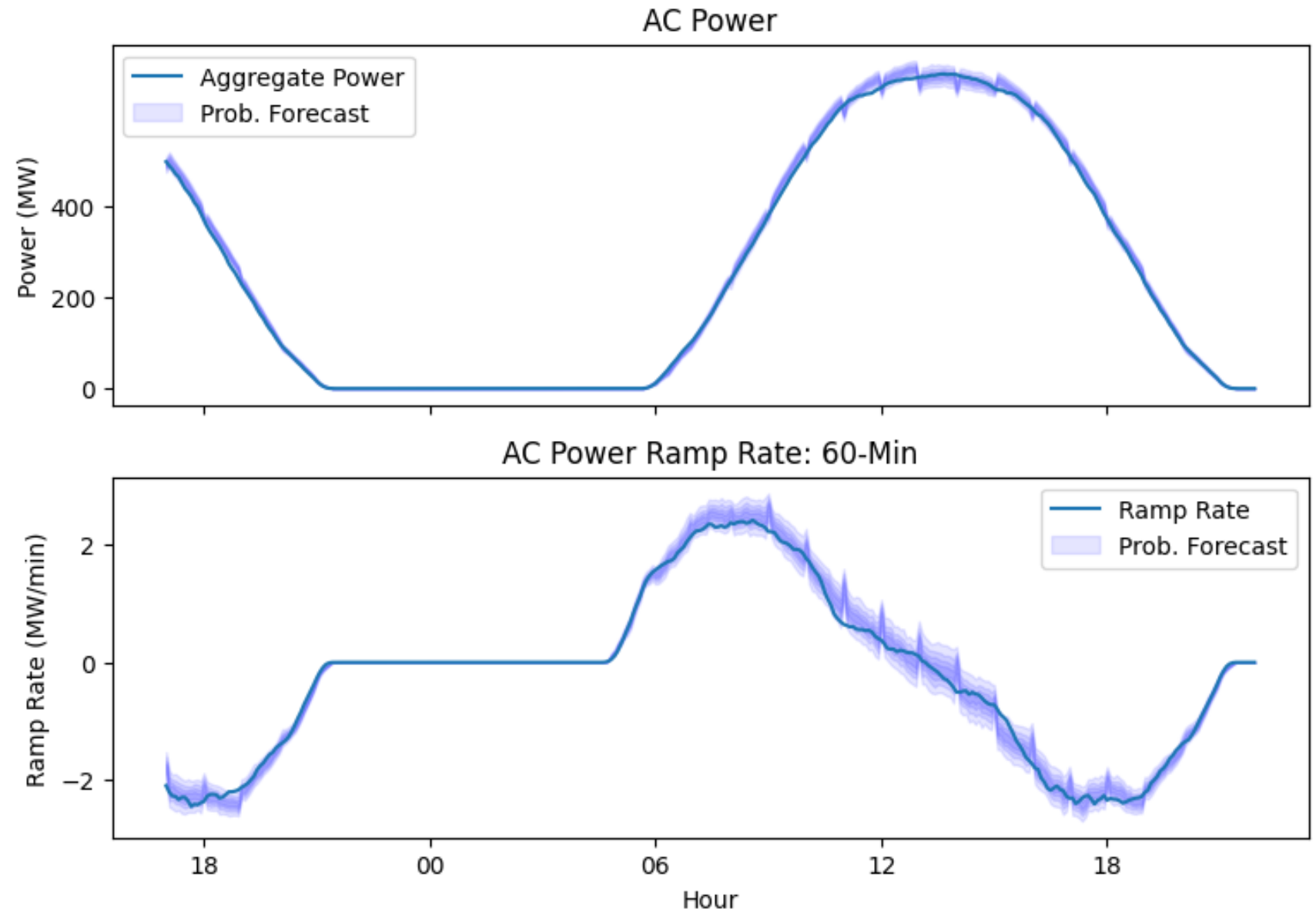
AC Power, Fleet Size = 3



AC Power, Fleet Size = 100



Forecasts Accounting for Derated Fleet Members



Thank You

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