

Weather Impacts on System Reliability with High Renewable Generation

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Better models. Better decisions.

Thesis

Weather matters in determining system reliability with high renewables and batteries.

Batteries are necessary for helping to solve problems of intermittent renewable generation.

Batteries and renewables alone aren't sufficient to meet load and maintain resource adequacy.

Thermal generation will remain an essential component of high renewable systems.

Weather Drives System Reliability Planning Conditions

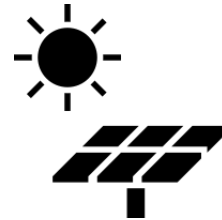
Weather drives load and renewable generation



Simulated Weather

PowerSimm™ captures the interactions of weather → renewables, load and storage level

Simulated renewables generation & load



Solar

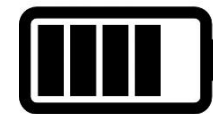


Renewables



Load

Battery Charge level



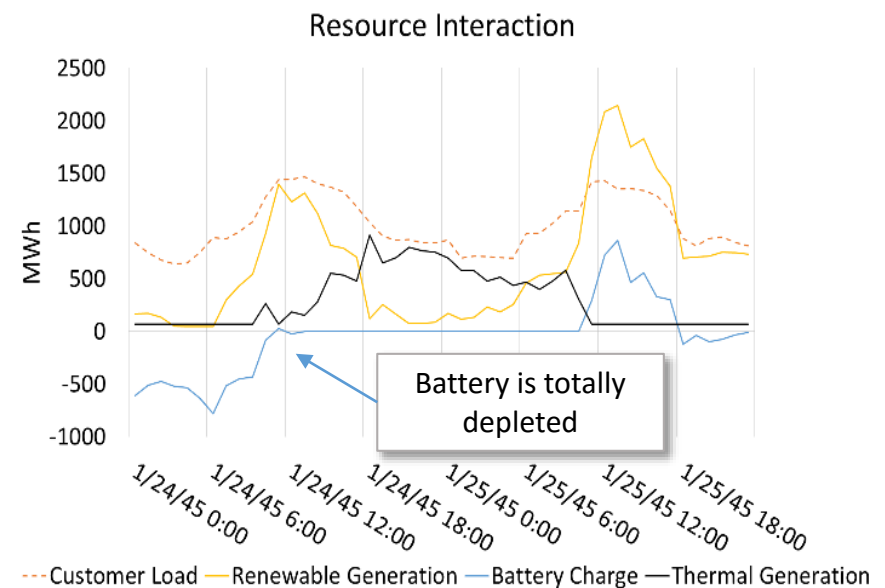
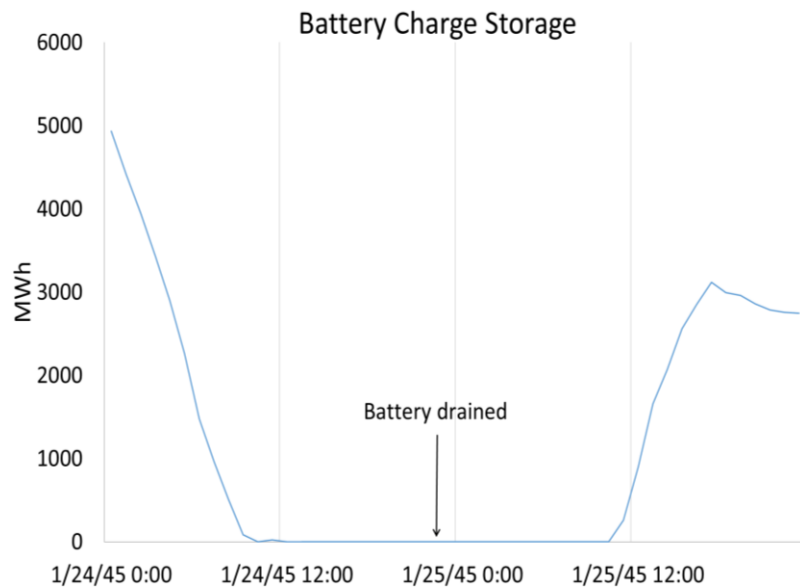
Battery Charge level



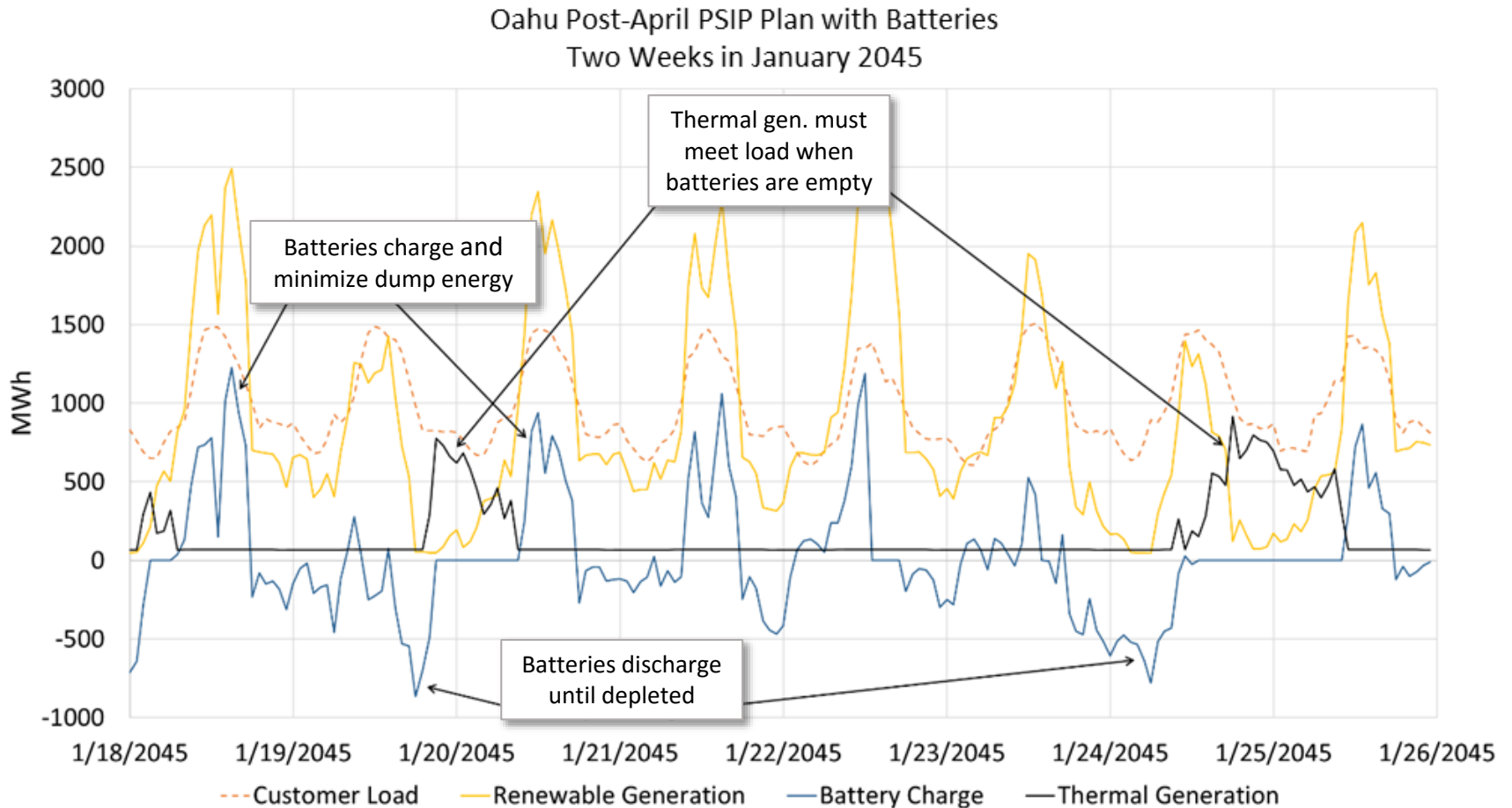
Capability to serve peak load

Batteries solve some problems of intermittent renewable...but, they don't solve all the problems

- Sometimes batteries aren't enough to make up the difference between renewables and load (i.e. meet net-load).
- Due to little solar and wind generation, the battery completely discharges early in the day and thermal generation must ramp up, serving over 80% of load during the night.



Thermal generation is essential to meeting load

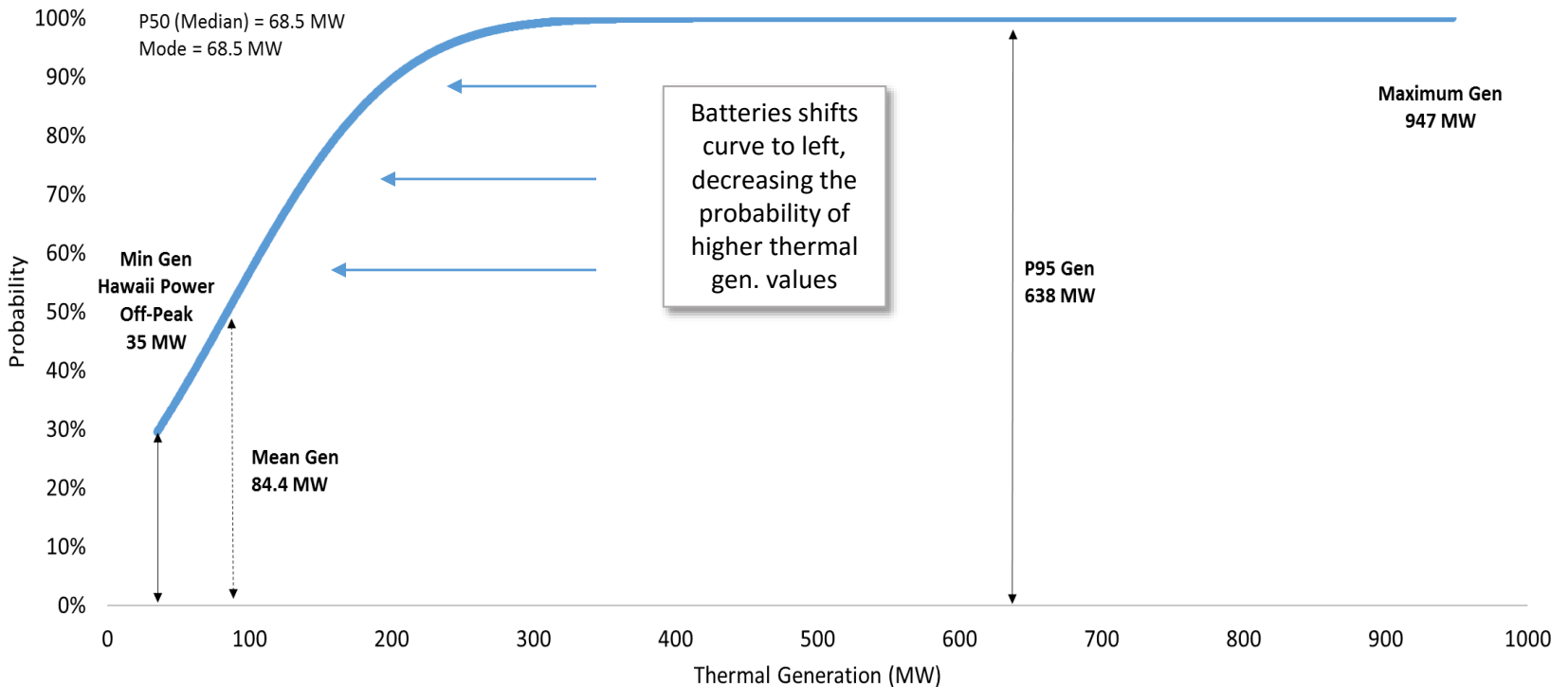


- **Thermal generation must still ramp up to provide energy** when the batteries' charge is depleted.
- Winter month weather conditions are cloudy (minimal solar gen.) can't meet load and batteries can't charge, forcing thermal generation to pick up the slack.

How much thermal generation do I really need?

Thermal Generation Cumulative Probability **With 7,000 MWh of Batteries**

Oahu Post-April PSIP Plan - 2045



- Batteries reduce the amount of thermal generation that will be needed overall .
- Batteries decrease average thermal generation by 68%, from 260 MW to 84.4 MW.
- Batteries decrease maximum thermal generation by 20%, from 1182 MW to 947 MW.
- **Even with batteries**, Oahu must still be prepared to provide 947 MW of thermal generation, a significant amount.

Thermal Generation With Batteries (7,000 MWh)

