Using Product Portfolios to Increase the Value of Customer-Sited PV

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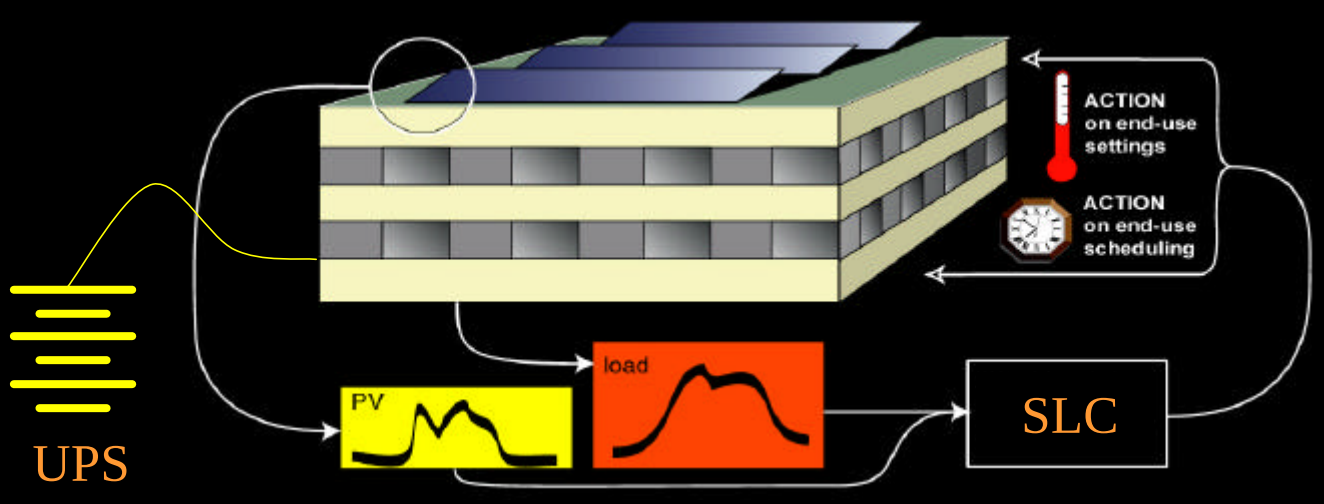
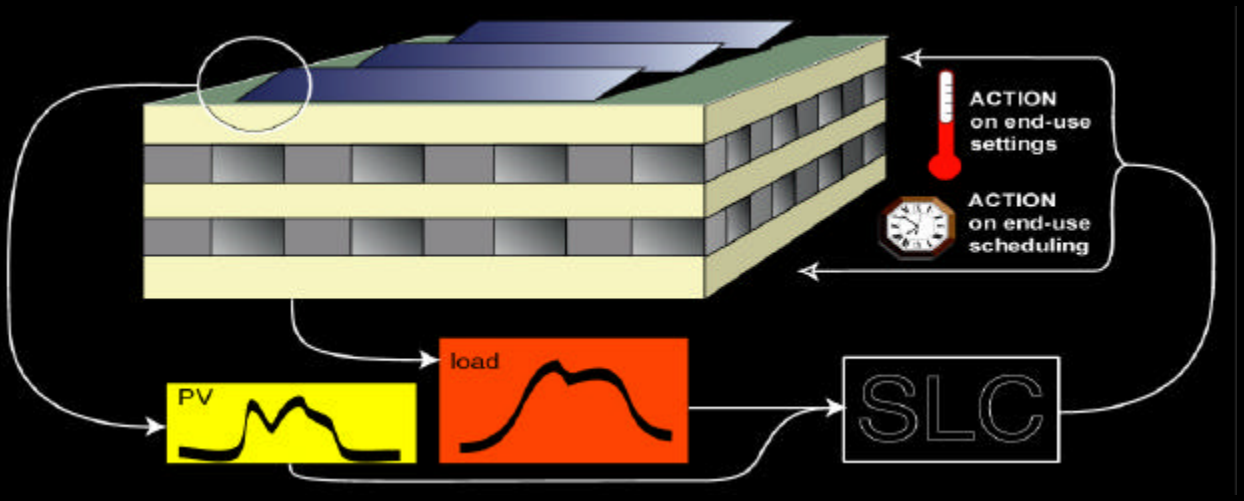
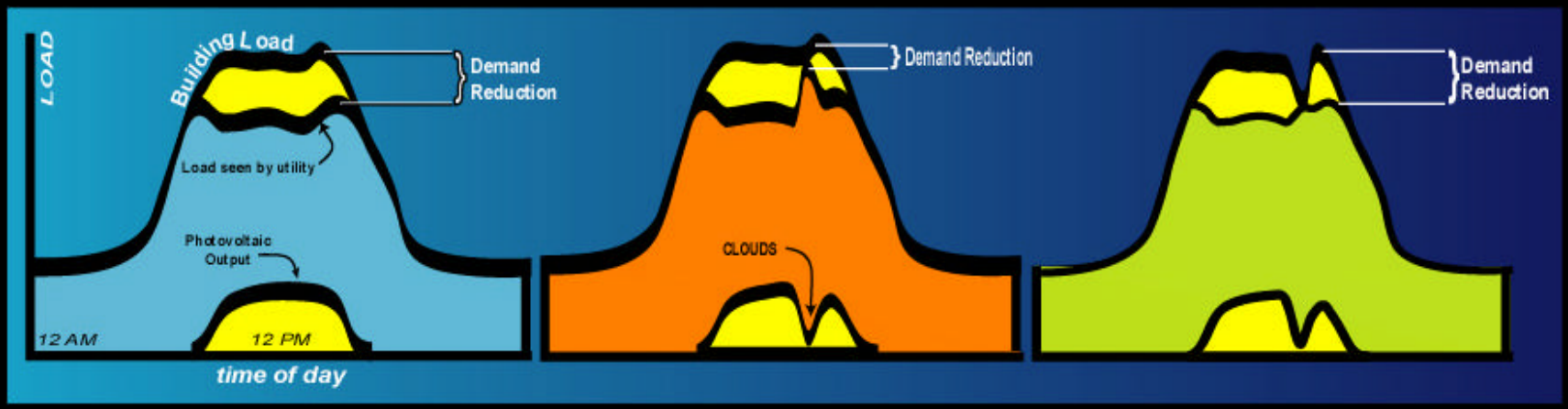
OBJECTIVES

1. Modify the Clean Power Estimator software program to estimate the value of added demand reduction (through use of Solar Load Control - SLC) and enhanced UPS efficacy when they are included in a portfolio of products that include PV.
2. Validate the accuracy of the model as compared to measured building load and PV output data.

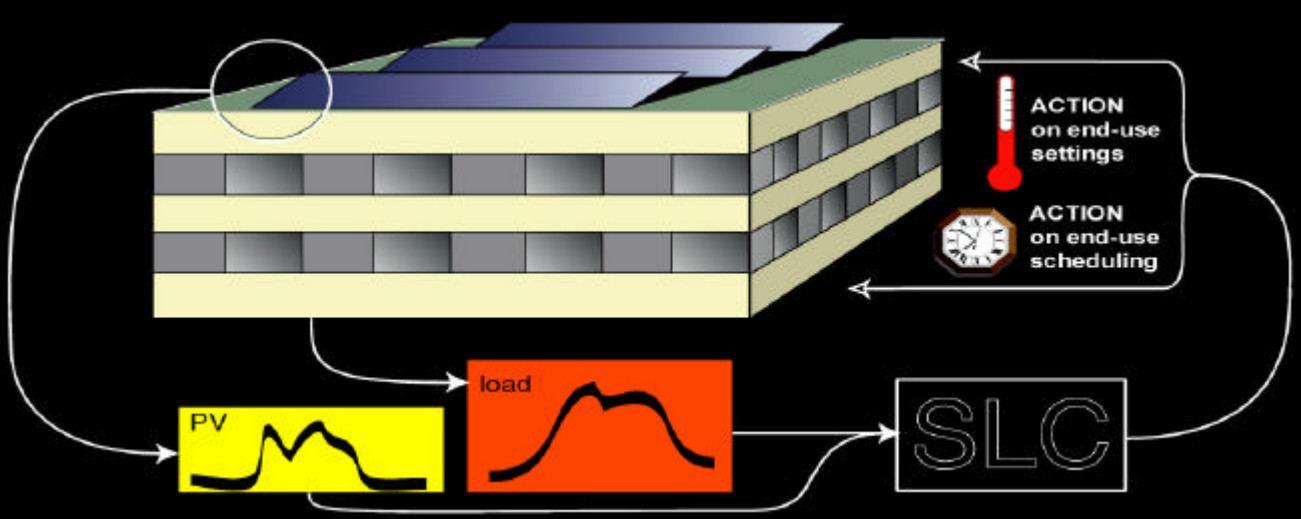


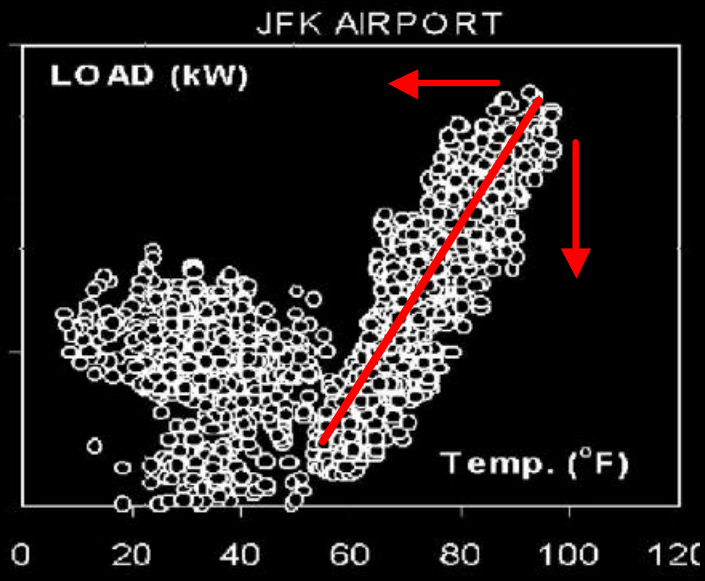
The Solar Load Controller





The Solar Load Controller





CLEAN POWER ESTIMATOR

Click Here to Start Estimator

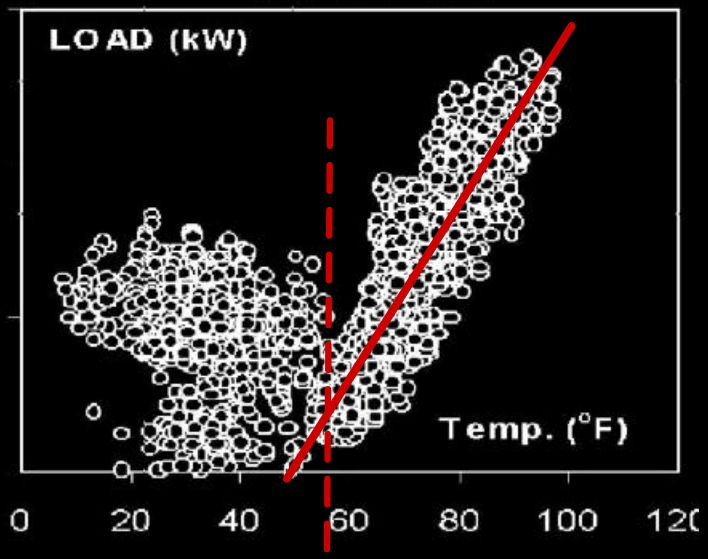
Standard CPE input

- Location
- PV array size, geometry
- Financial specifics

SLC-specific input

- Allowable maximum daily degree-hours
- Seasonal building load profiles*
- Building balance point*
- Building temperature coefficient*

** Defaults available*



Output

- Achieved demand reduction
- Investment bottom lines

TMY

TMY data have been condensed into daily values for fast Web export to host computer

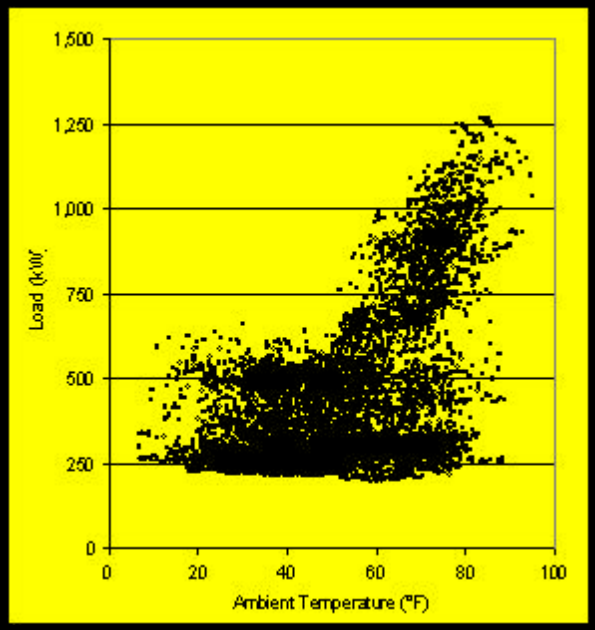
CPE generates synthetic hourly values from daily values on host computer

CPE generates hourly PV output and building loads

CPE calculates demand reduction, economics, etc.

CLEAN POWER ESTIMATOR

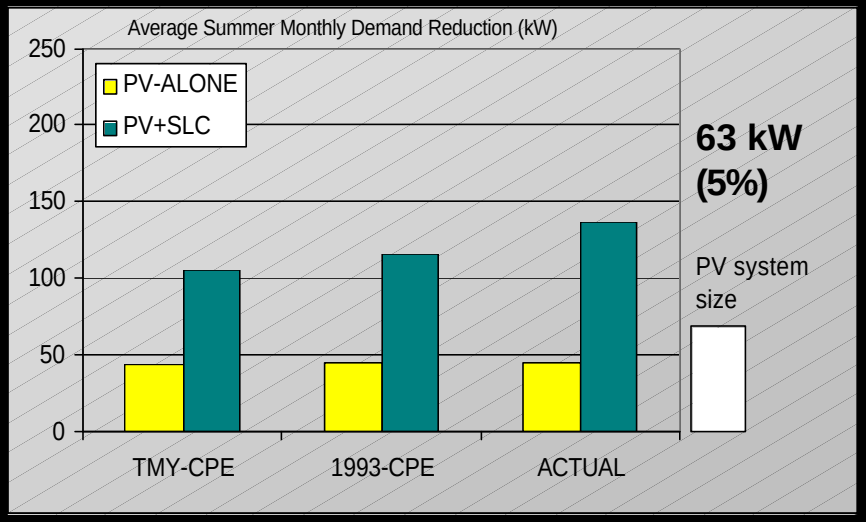
VALIDATION



Westchester County Building
1993

Compare

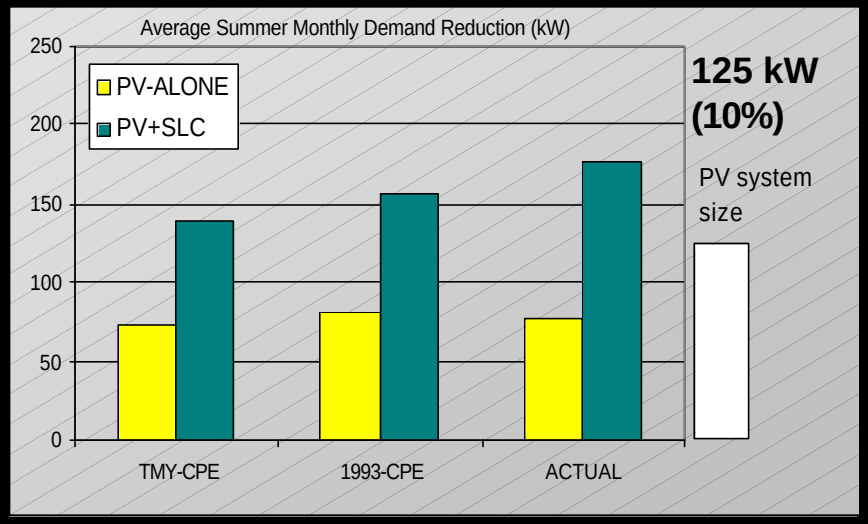
- TMY-based CPE results
- 1993-based CPE results
- "True" 1993 load and solar resources results

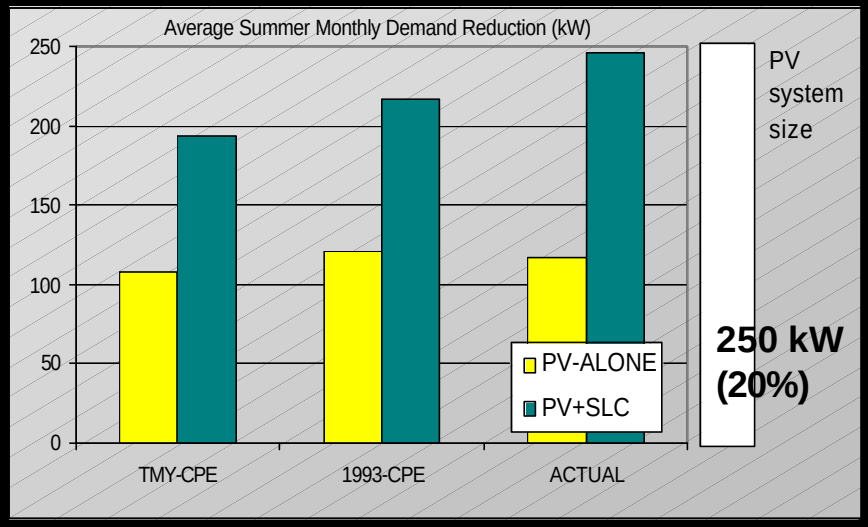


VALIDATION

Achieved demand reduction with, and without SLC* for several PV penetration levels

**SLC set at 10 degree-hours*

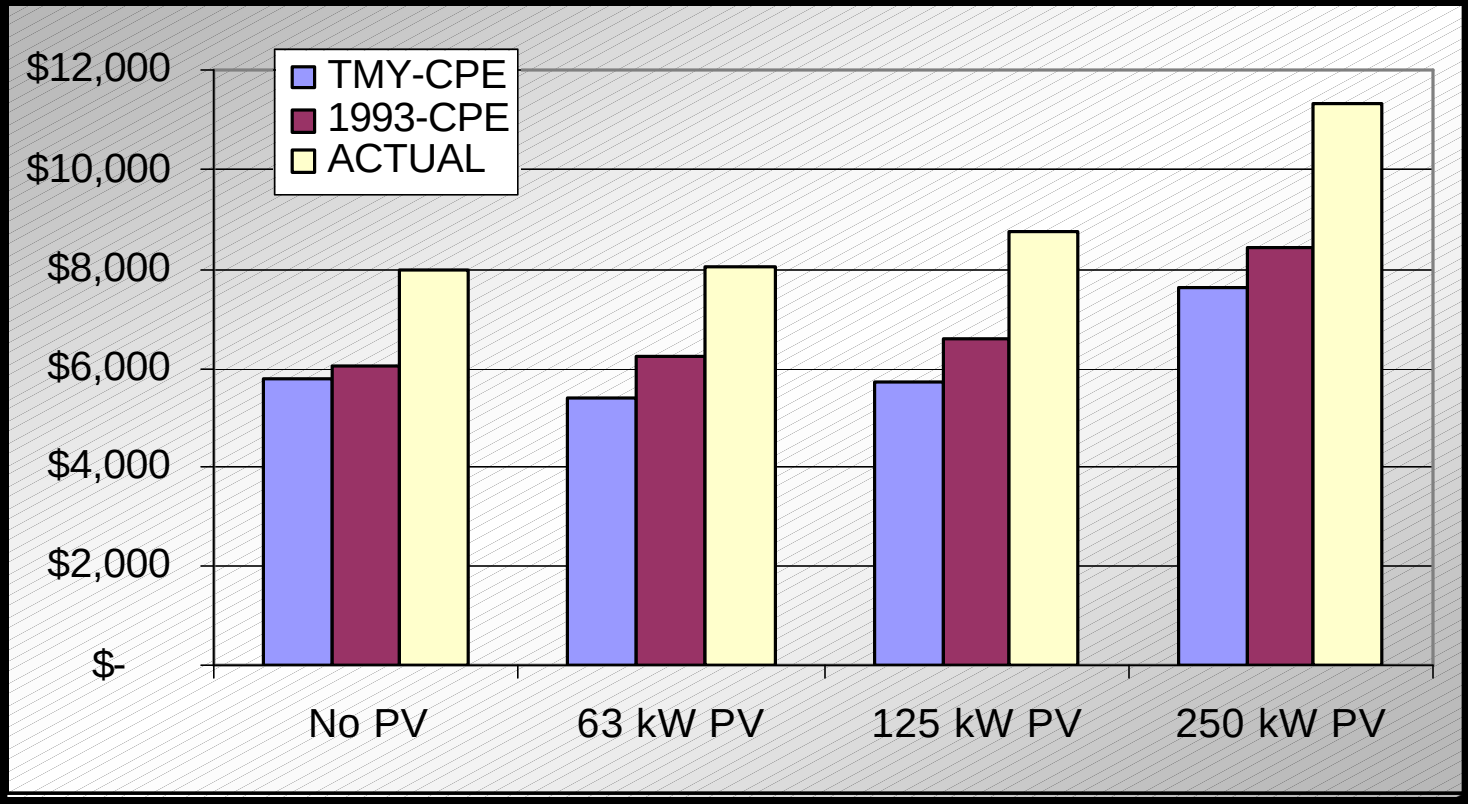




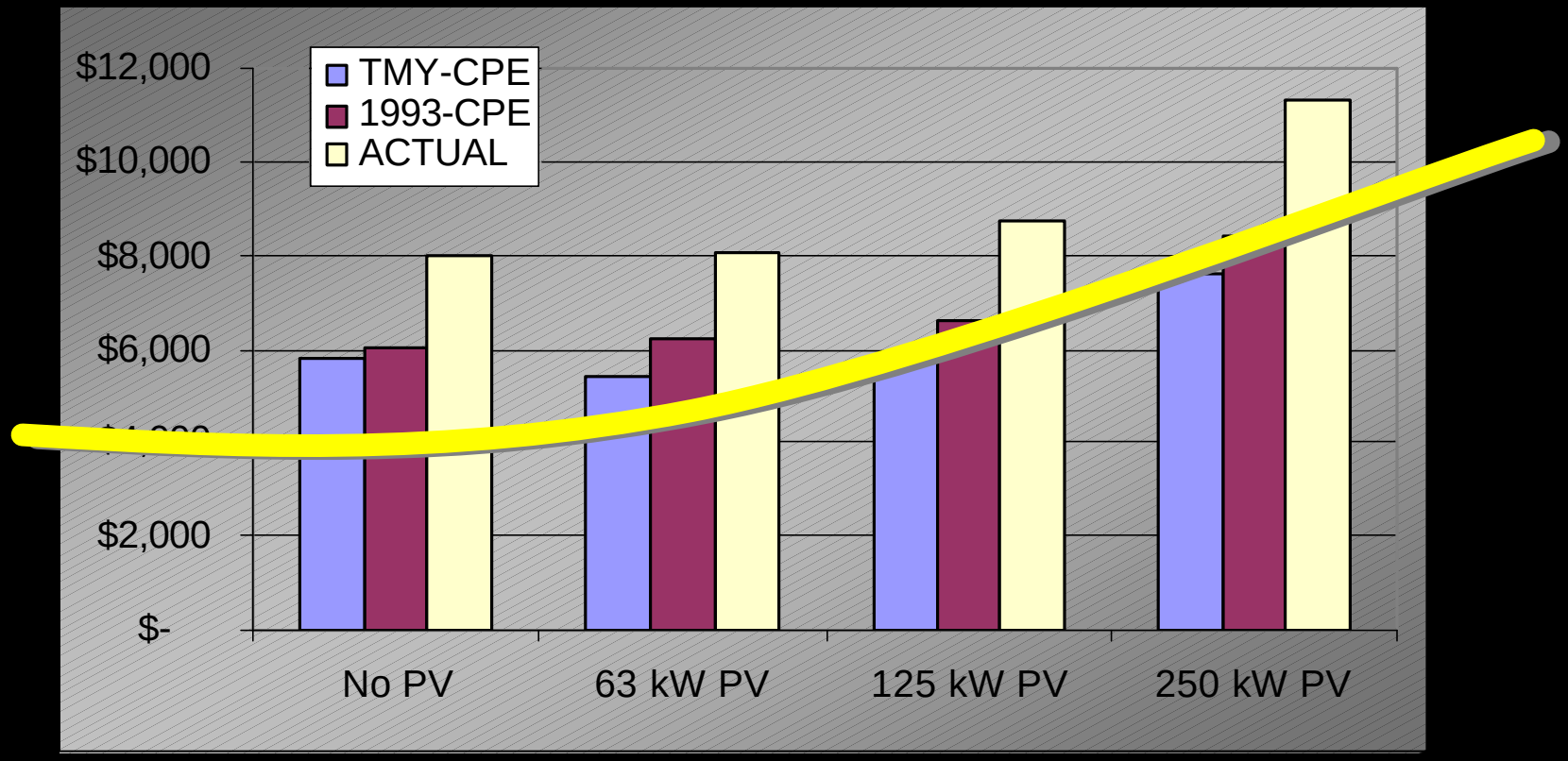
…CPE results are comparable to results based on actual data while being on the conservative side

VALIDATION

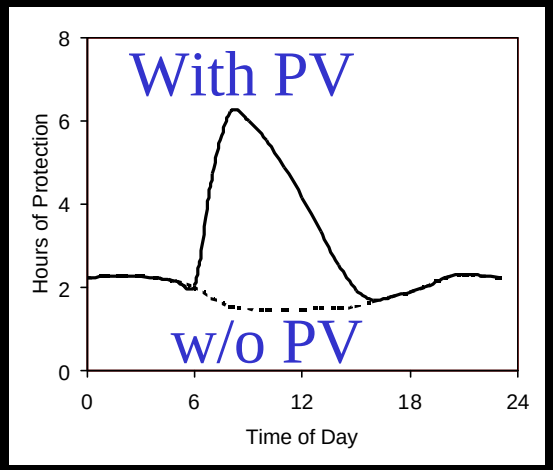
First year value of SLC (*10 degree-hours max)* as a function of PV system size



PORTFOLIO EFFECT



Enhance UPS Efficacy w/ PV



Hourly PV output and building loads

Enhance UPS Efficacy

Determine critical load

Subtract PV output from critical load

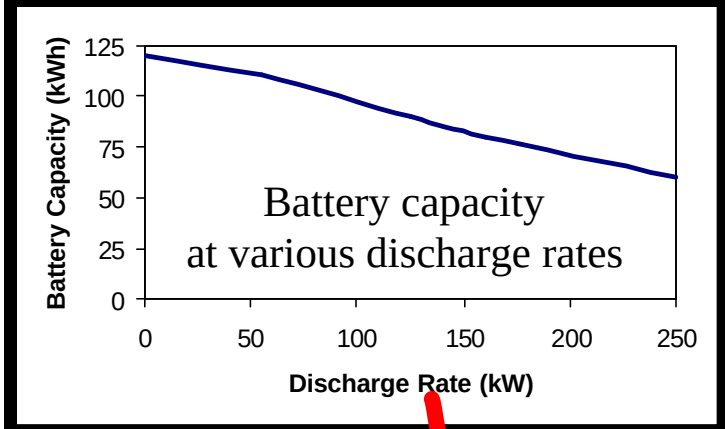
Calculate the outage prevention hours provided by the UPS for every hour

Summary statistics

Inputs to Evaluate UPS Efficacy

UPS-specific input

- Battery capacity at various discharge rates
- PV/battery charging efficiency
- Critical load



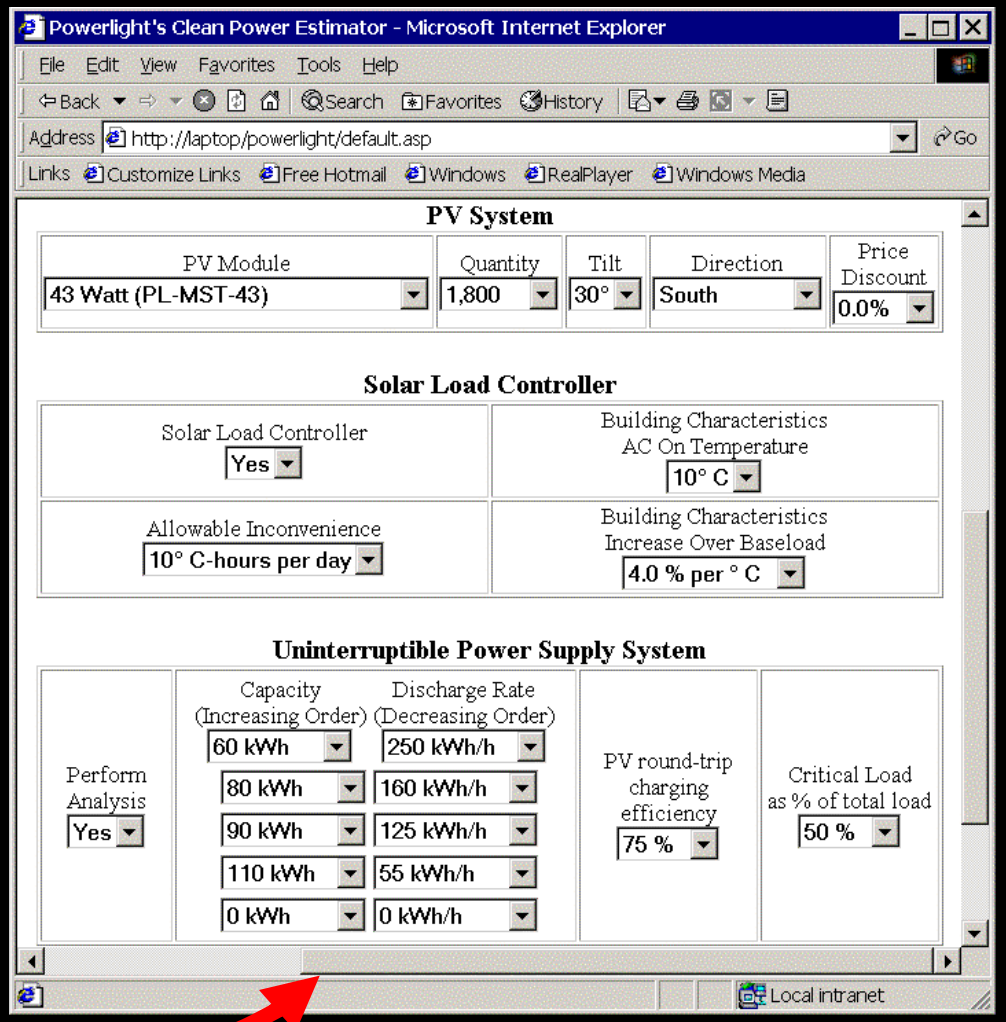
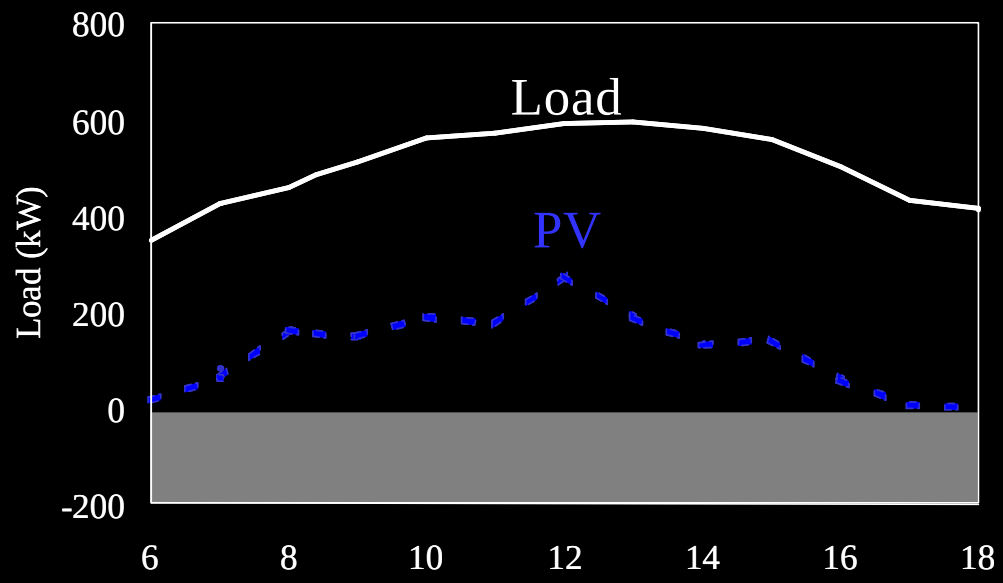


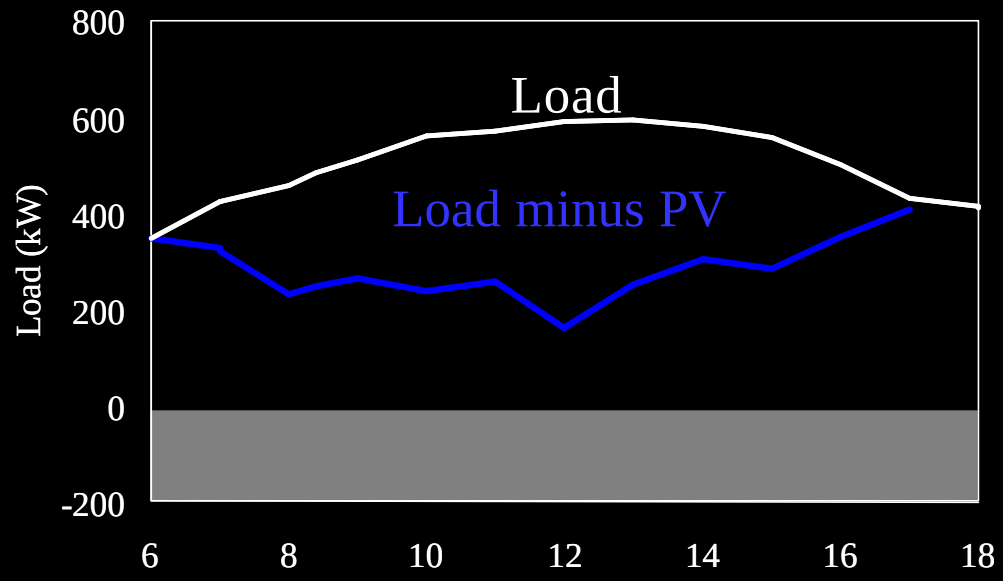
Illustration of methodology

- 250 kW_{AC} PV system
- 200 kWh of battery capacity
- Critical load is 33% of normal load
- Round-trip charging efficiency is 75%

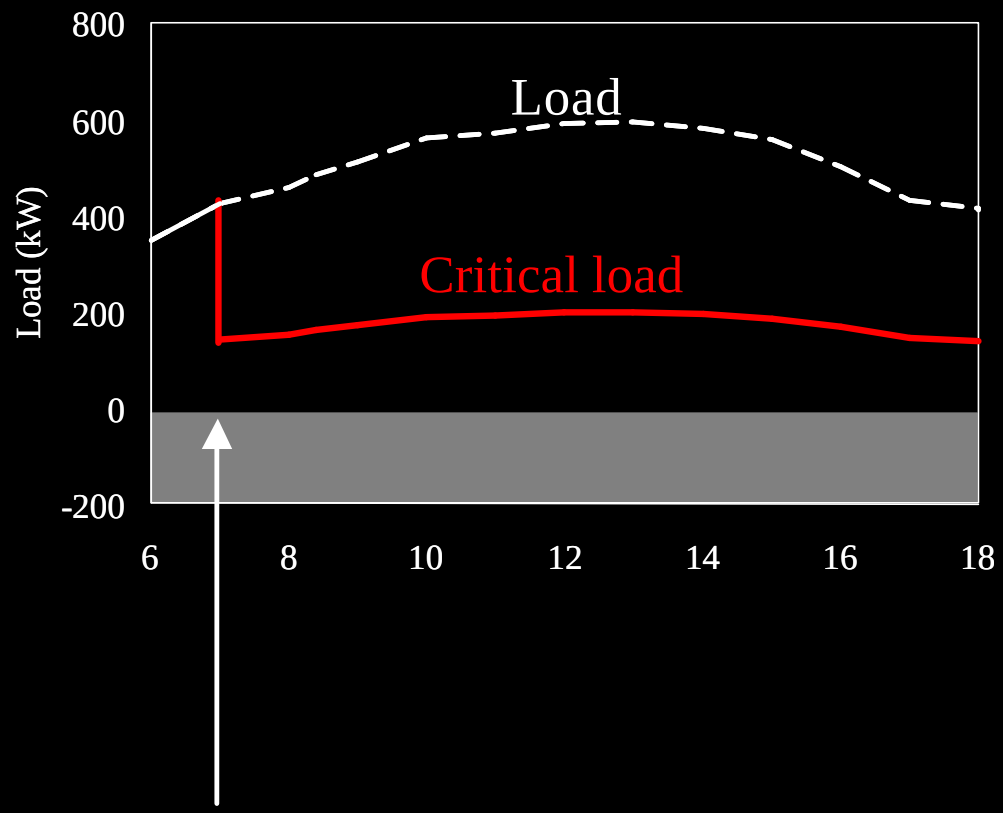
Load and PV on April 5



Load and load minus PV on April 5

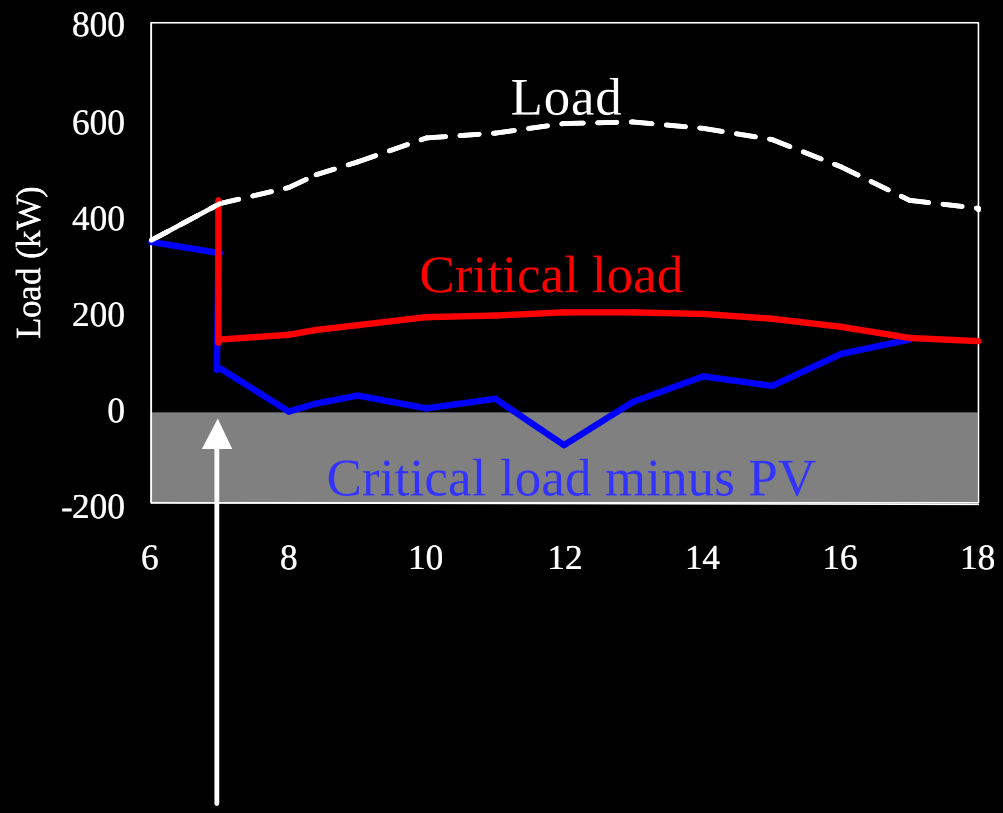


Critical load after 7 AM outage on April 5



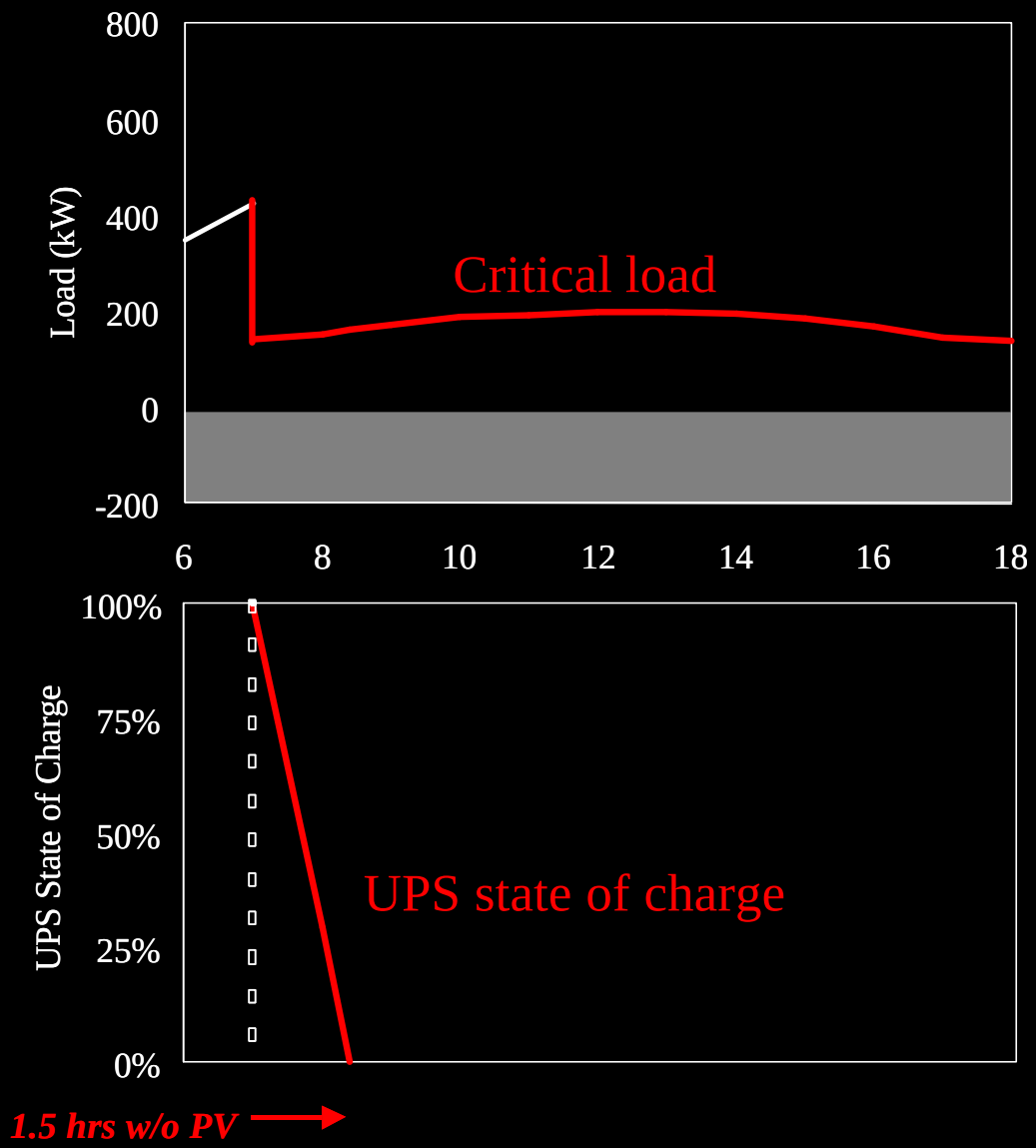
Outage starts
At 7 AM

Critical load after 7 AM outage on April 5

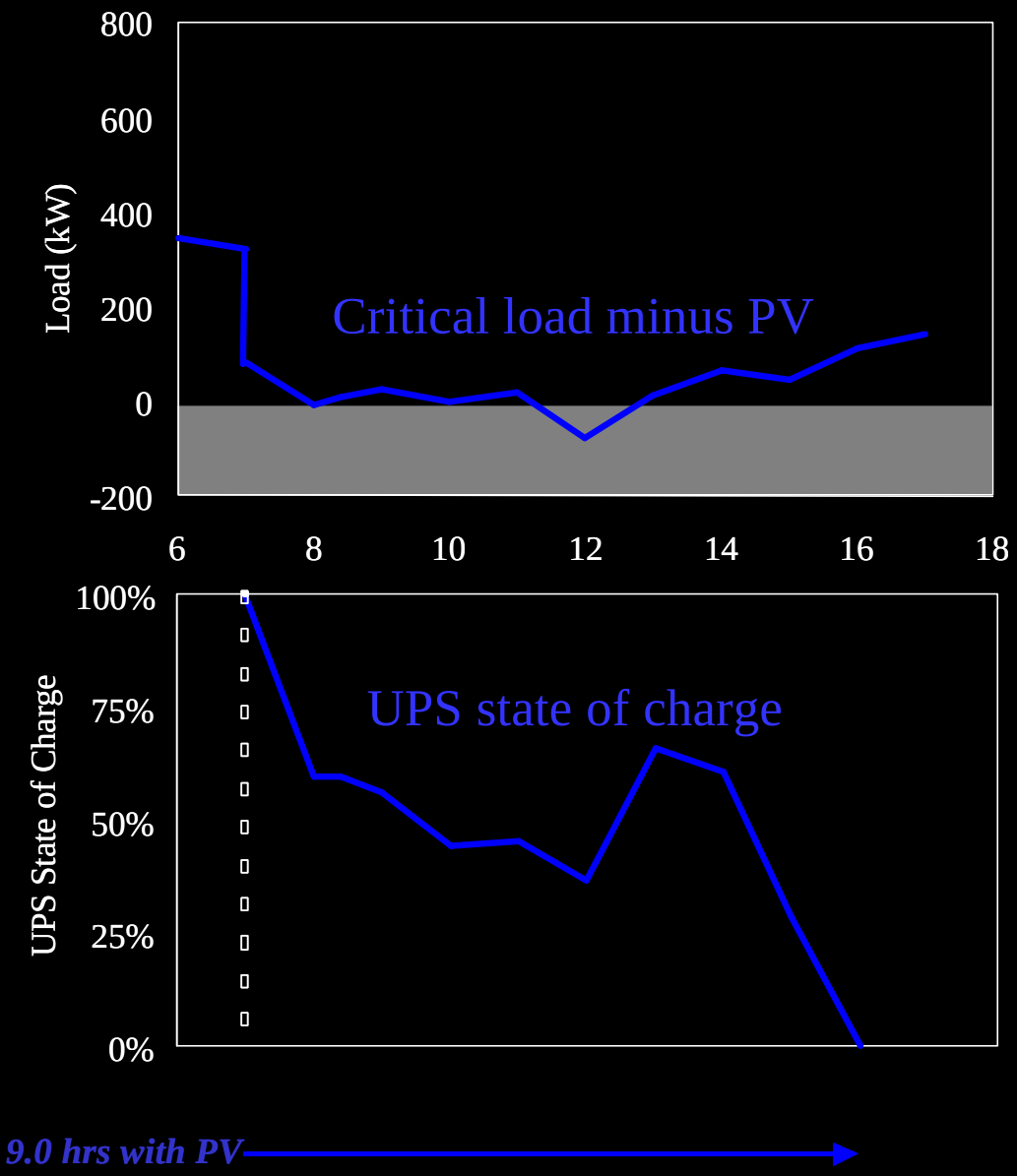


Outage starts
At 7 AM

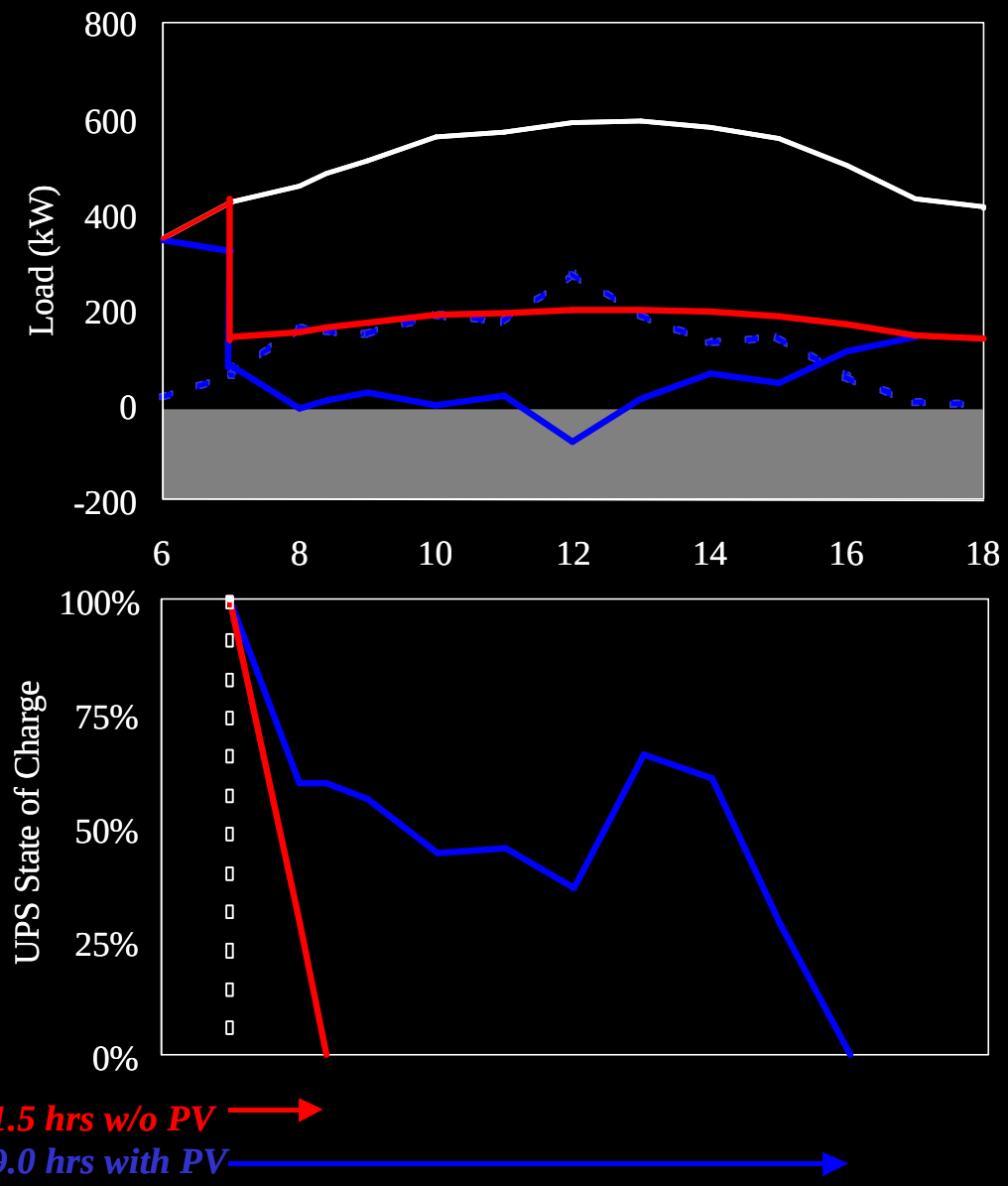
1.5 hours of protection without PV on April 5



9.0 hours of protection with PV on April 5



Evaluation of protection for a 7 AM outage on April 5

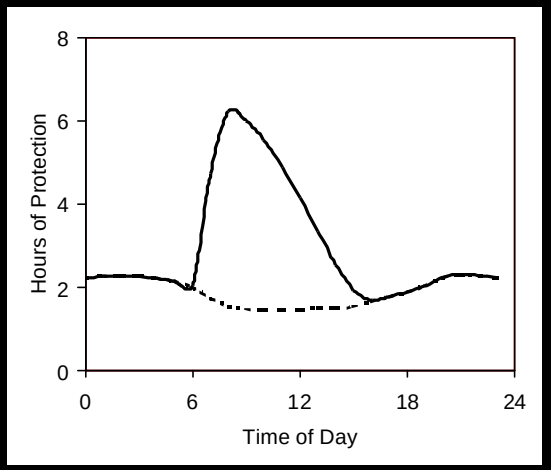


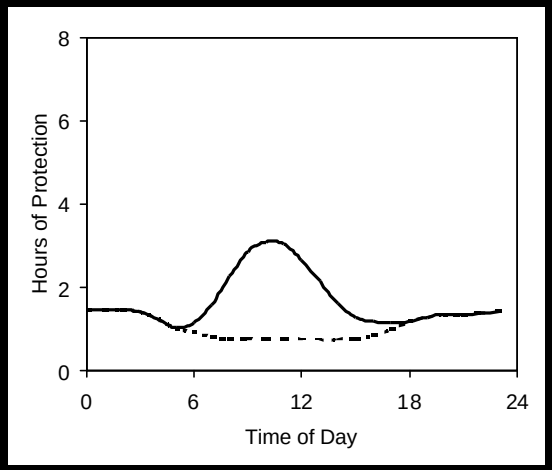
Summary for January and June

January

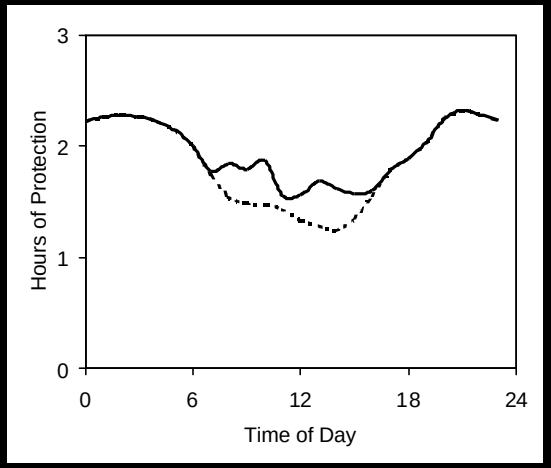
June

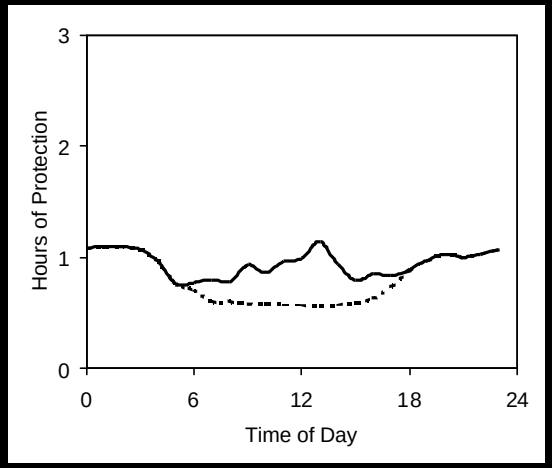
Average





Worst Case





Conclusions and Future Work

- Conclusions
  - The Clean Power Estimator is a good estimate of the actual economic value of the SLC
  - A UPS plus PV system can protect building owners from much longer daytime outages than a UPS system alone
  - Portfolio effect exists under certain product combinations
- Future work
  - Develop more refined load simulation model to improve accuracy on a monthly basis
  - Translate enhanced UPS outage protection results to economic benefit