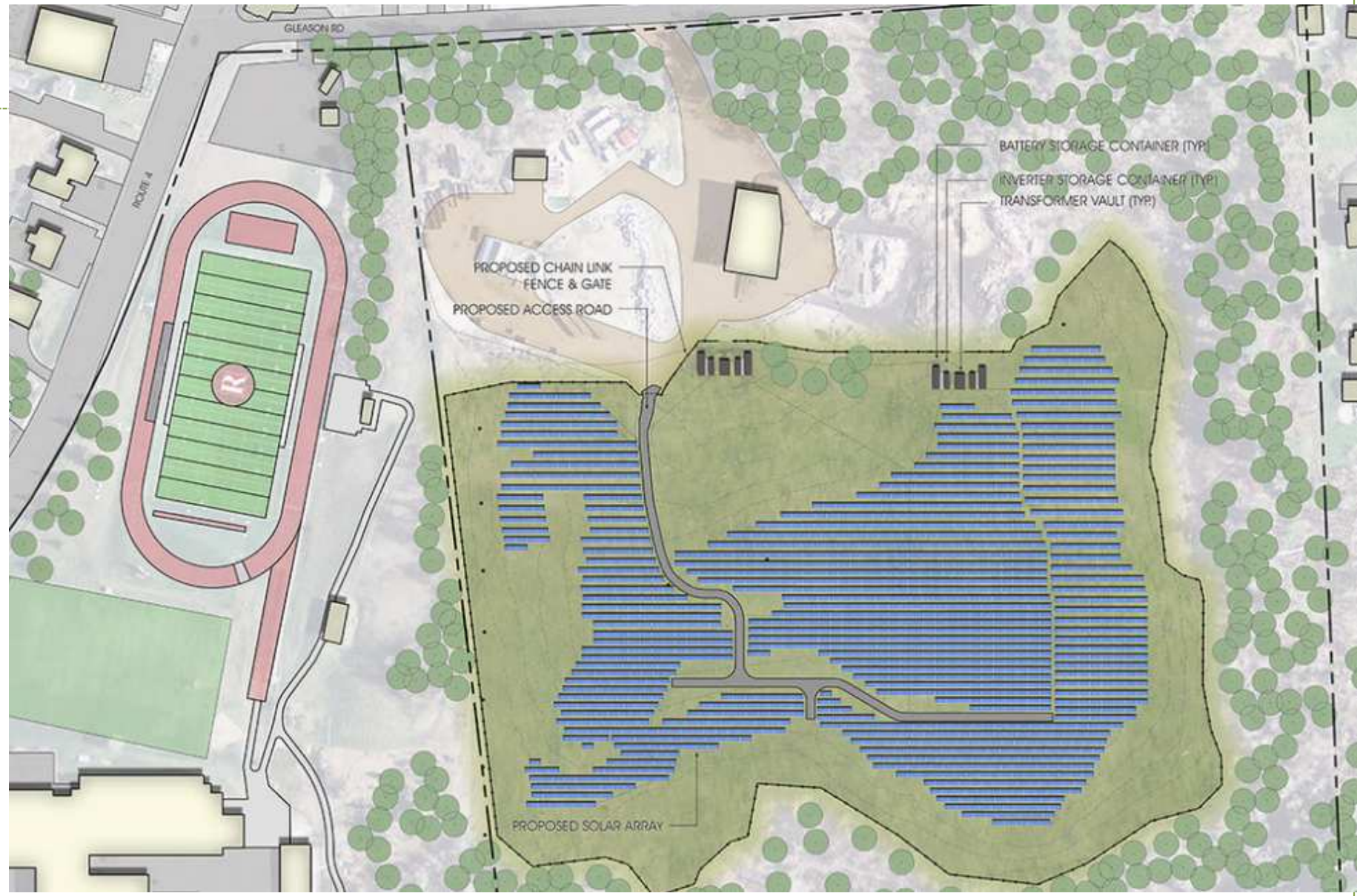
GMP SMART POWER

STAFFORD HILL STORAGE & SOLAR

Overall Objectives

- Shifting away from traditional grid to:
  - One that is more dynamic
  - Relies on both supply side AND customer load management
- Goal is to deliver value to Vermont:
  - Reduce & flatten GMP's peak to lower costs for customers
  - Integrate distributed, intermittent generation resources
  - Improve the operational efficiency of the grid


GLEASON RD
ROUTE 4
BATTERY STORAGE CONTAINER (TYP.)
INVERTER STORAGE CONTAINER (TYP.)
TRANSFORMER VAULT (TYP.)
PROPOSED CHAIN LINK FENCE & GATE
PROPOSED ACCESS ROAD
PROPOSED SOLAR ARRAY

2.5 MW Solar

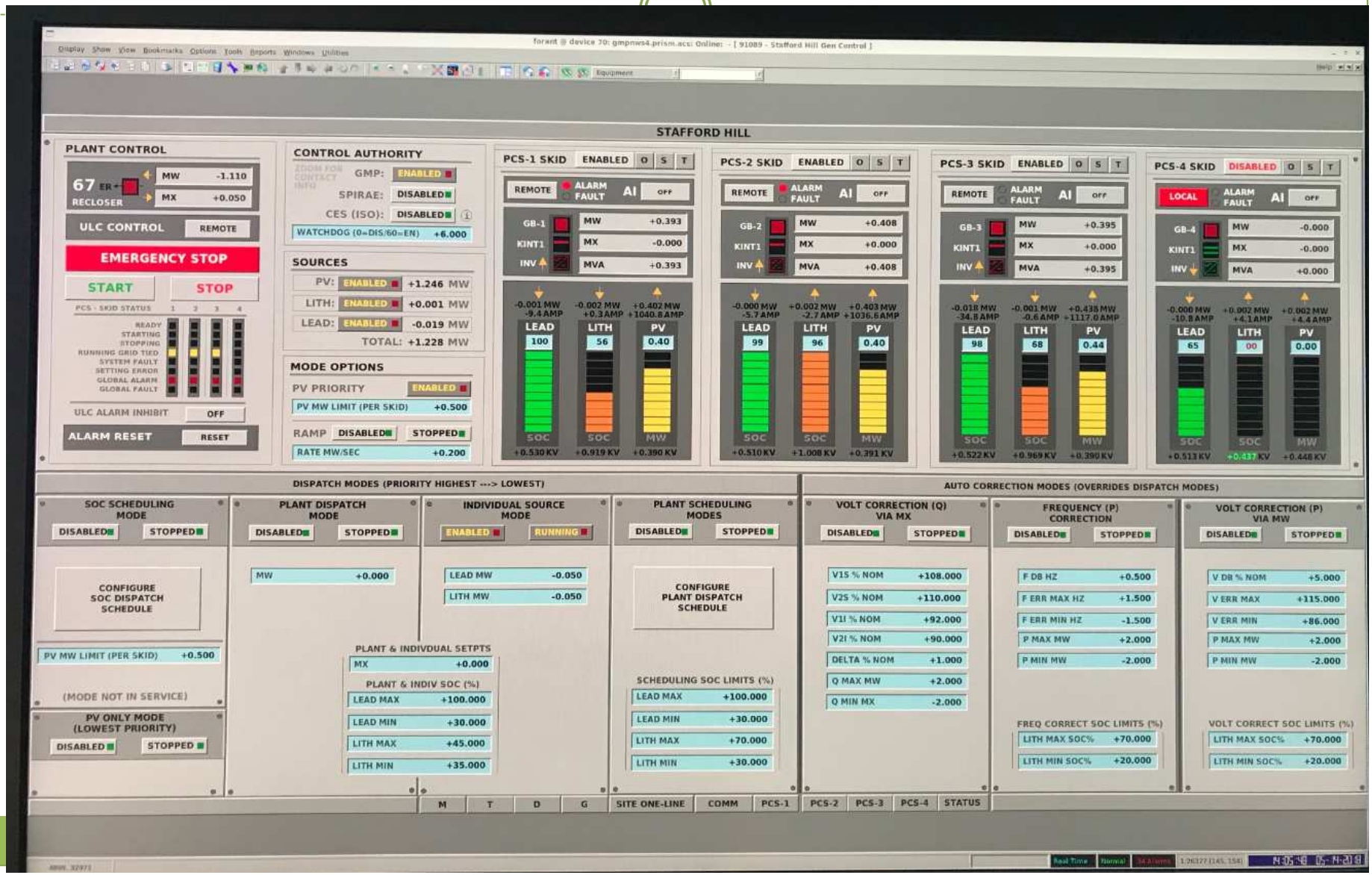
Concrete ballast mount to avoid penetrating landfill cap

Over 7,000 panels

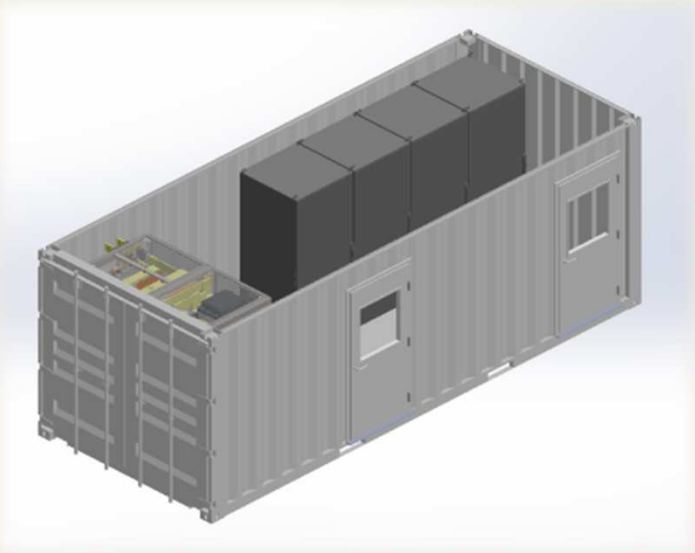
Battery Storage Containers (set 1 of 2)


PowerSafe

Control From SCADA



Stafford Hill Solar & Storage Specs

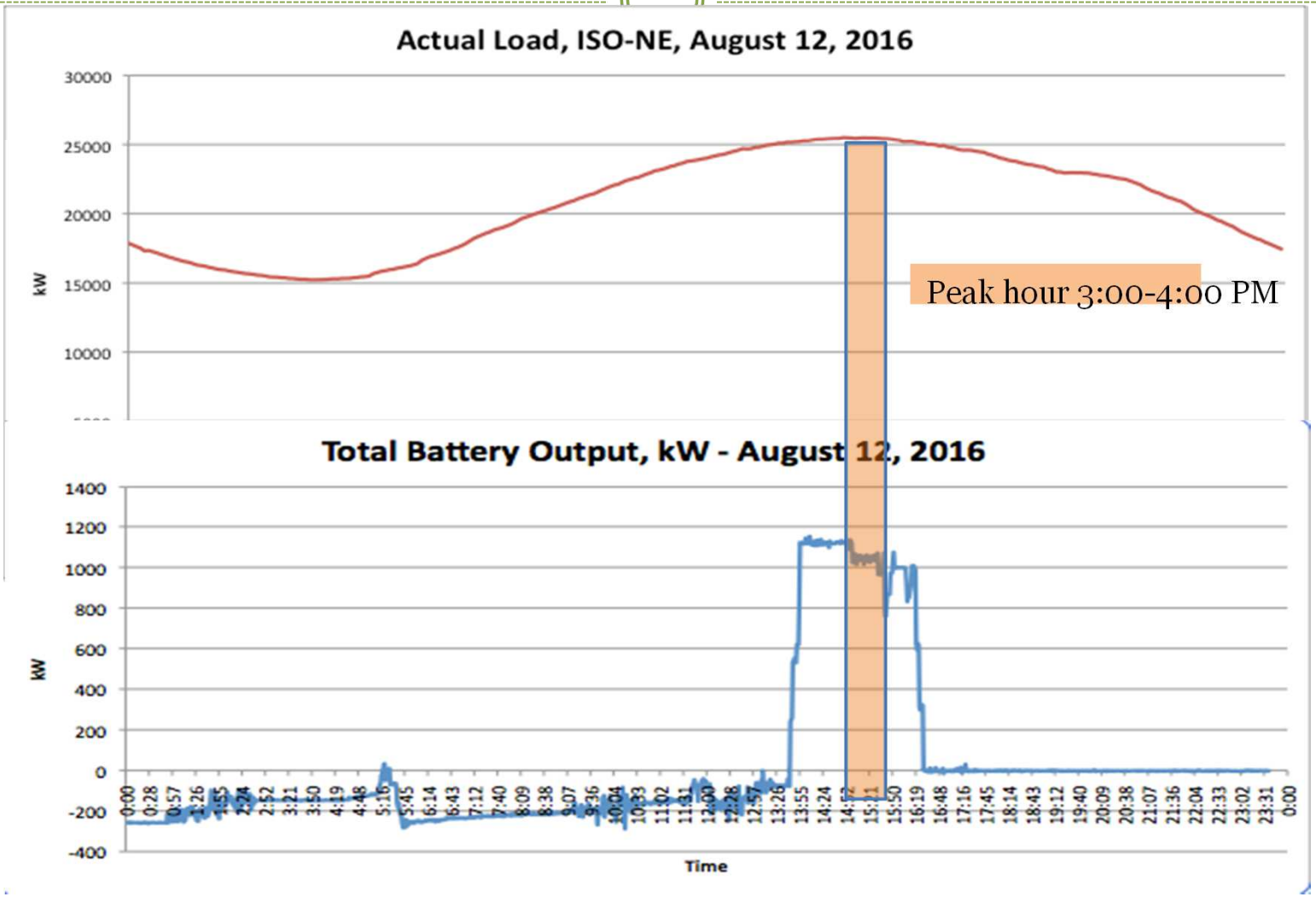


Stafford Hill Solar + Battery

- 2.5 MW Fixed Solar on Landfill Cap
- 2MW/1MWH Lithium Ion Batteries
- 2MW/2.4MWH Lead Acid Batteries
- 4 – 500KW Multiport Inverters

Value Propositions of Stafford Hill

#1 – Peak Reduction
2016 Summer Peak Actuals

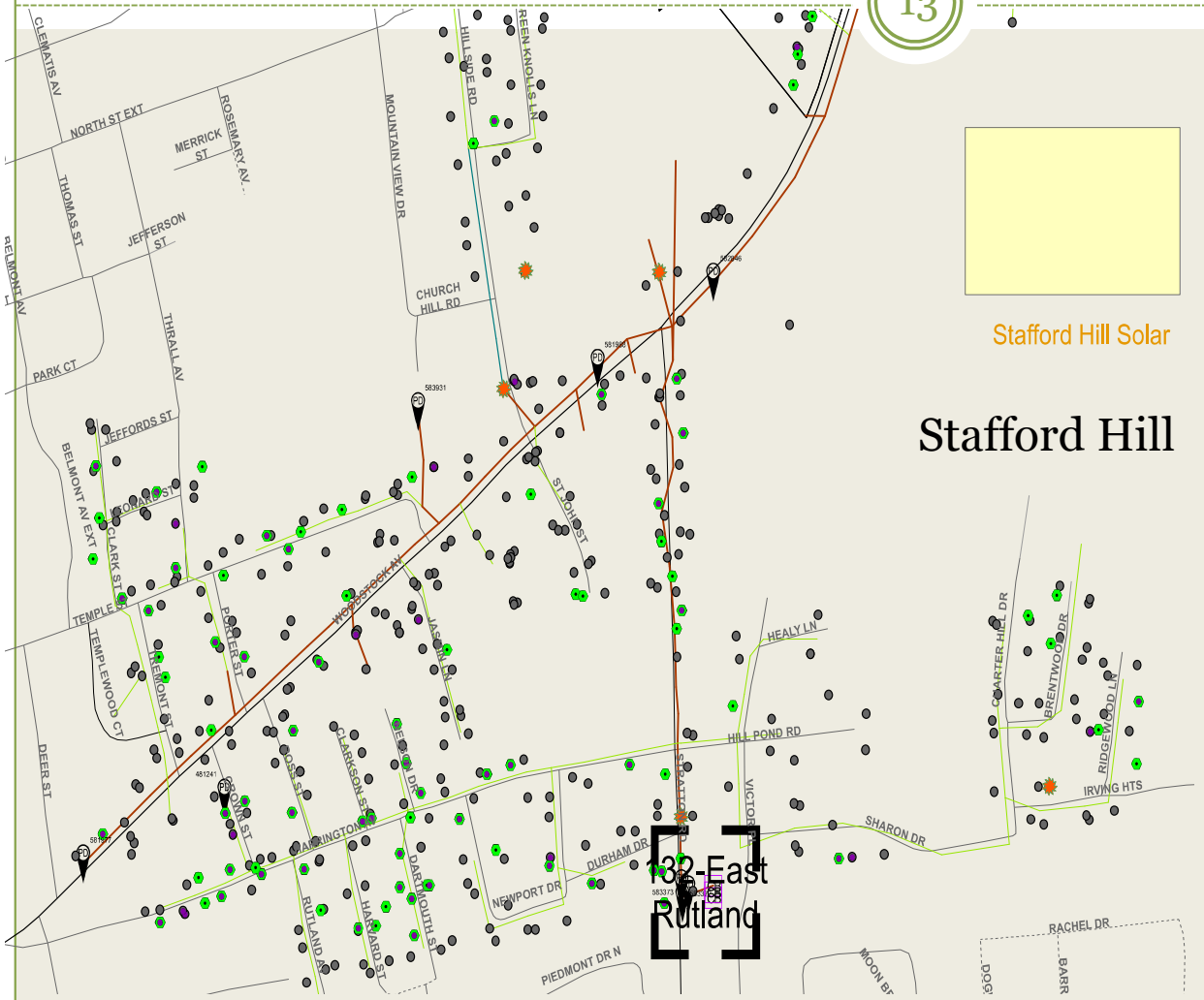


#2 - Frequency Regulation

#3 Energy Arbitrage

Charge batteries when LMPs are low, discharge when they are high.

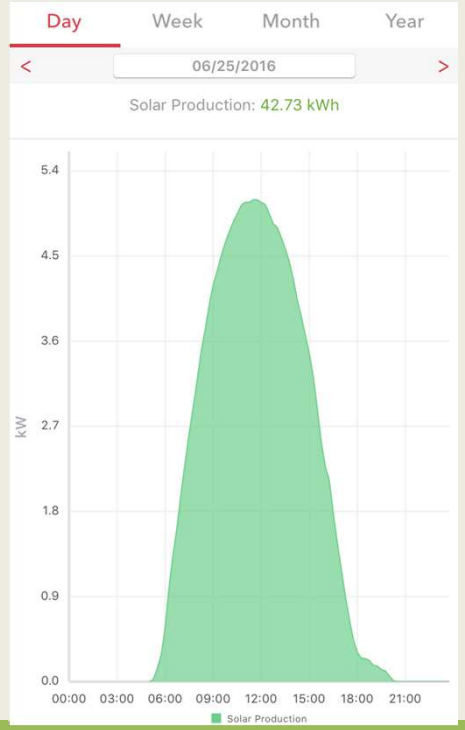
#4 Microgrid part of E. Rutland Circuit

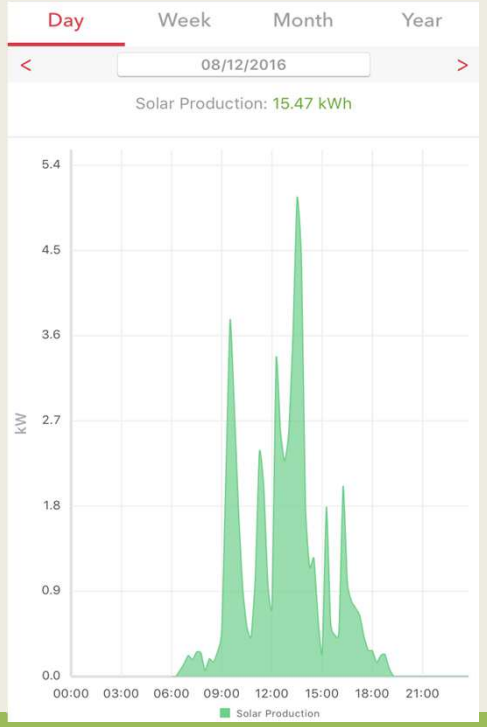


- 3.4 MWH battery storage
- 150 controllable water heaters
- Micro-Grid controls

#5 Storage Helping with Portfolio "Wobble"

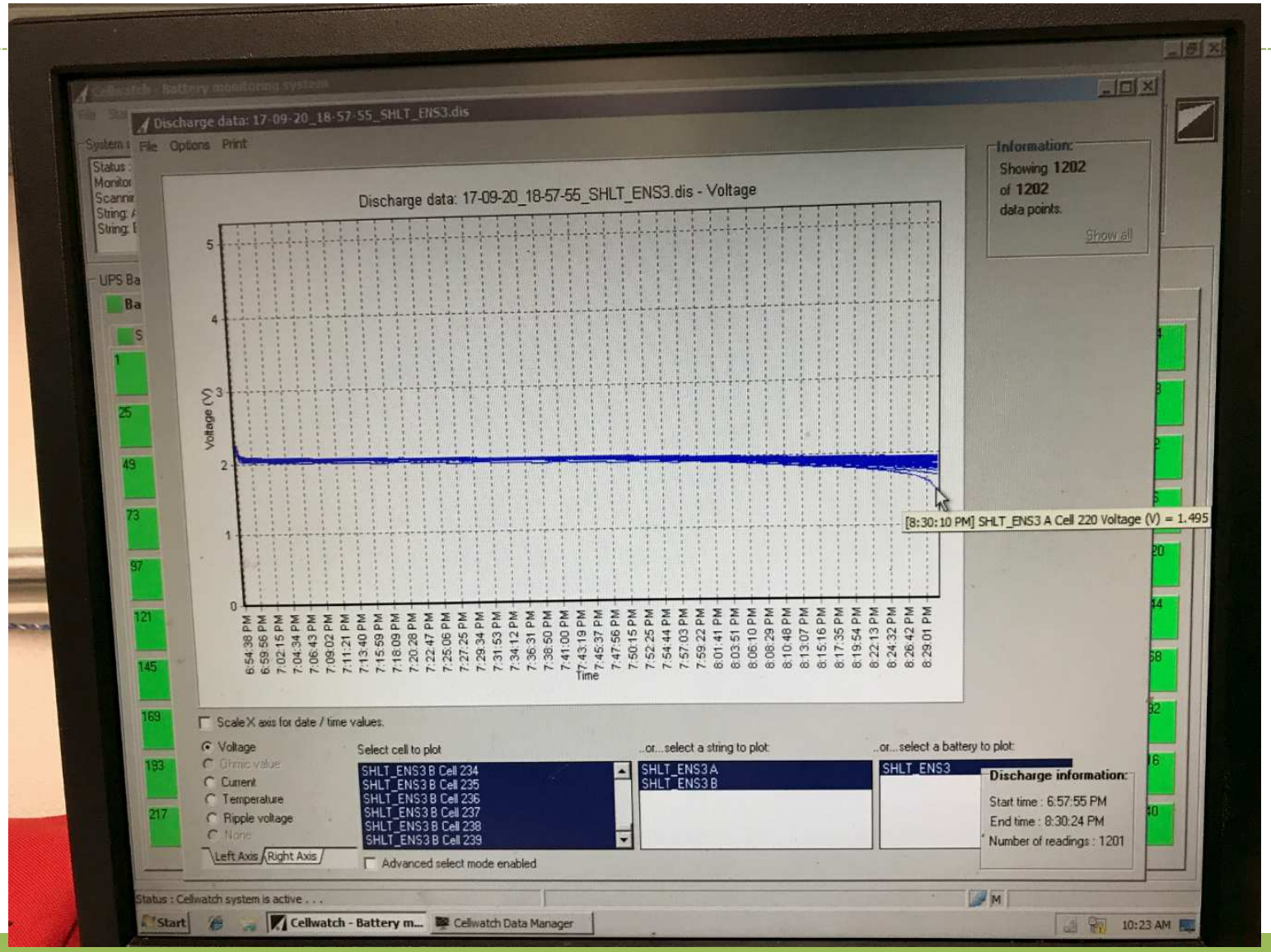
- Net metered solar capacity in GMP territory is now equivalent to 17% of the peak load and often a much larger fraction of typical loads
- When we add in larger scale distributed solar and other generation less than 5 MW in size, this number approaches 25%



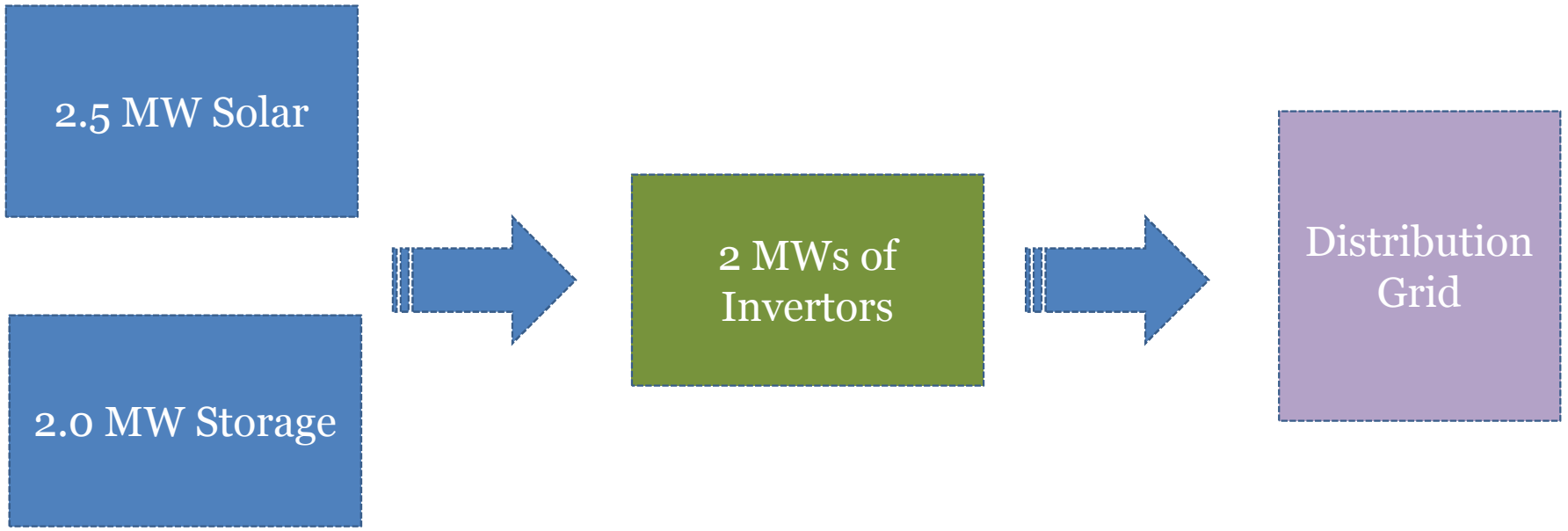


Observations to Date

Battery Cell Voltage Profiles



System Design Considerations



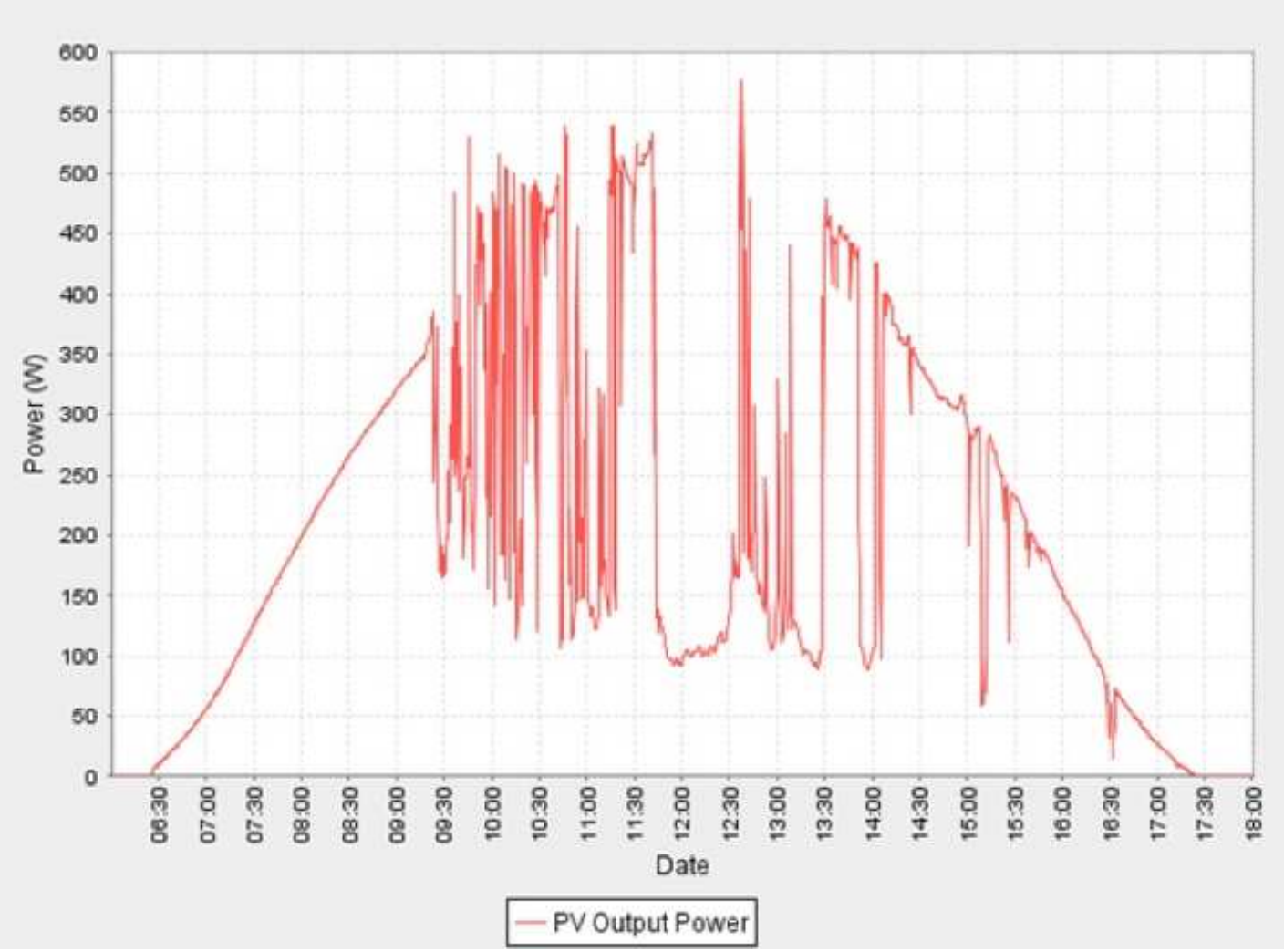
System Design Considerations (cont.)

These two are the same
and different…

4 MWh of Stored Energy

4 MWh of
Stored Energy

Priority to PV
Solar first, back fill “valleys” with batteries



Storage Beyond Stafford Hill

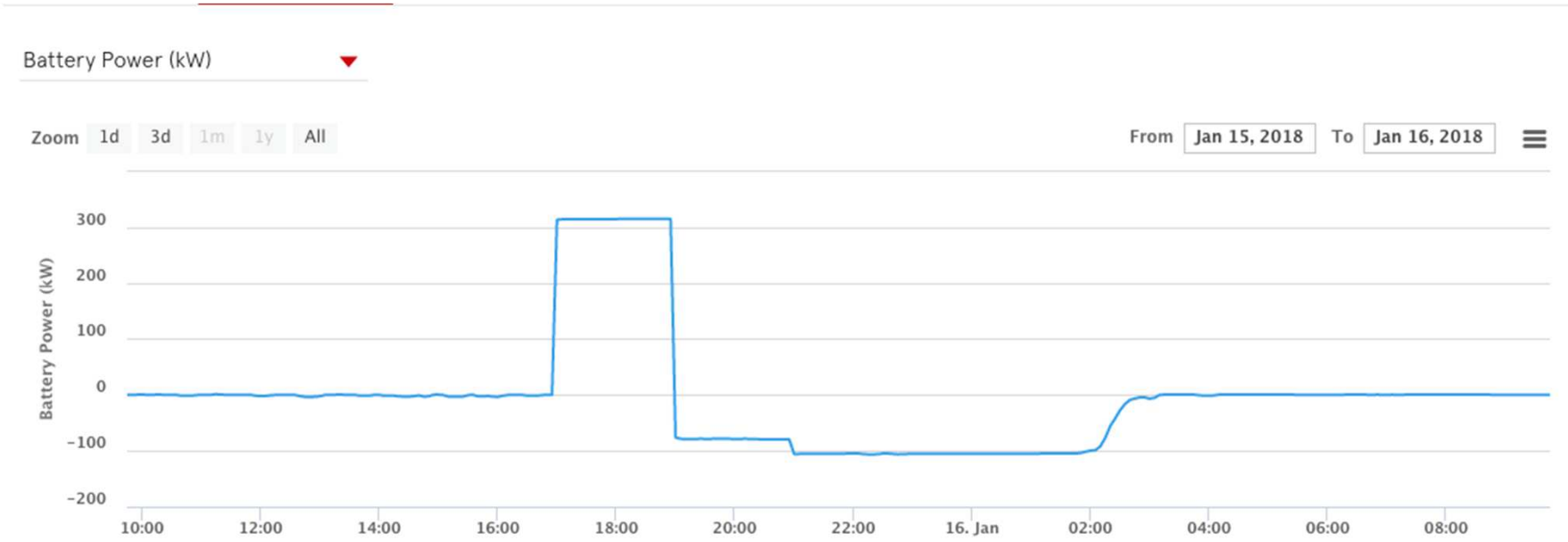
Tesla Power Walls

GMP Customer With PowerWall

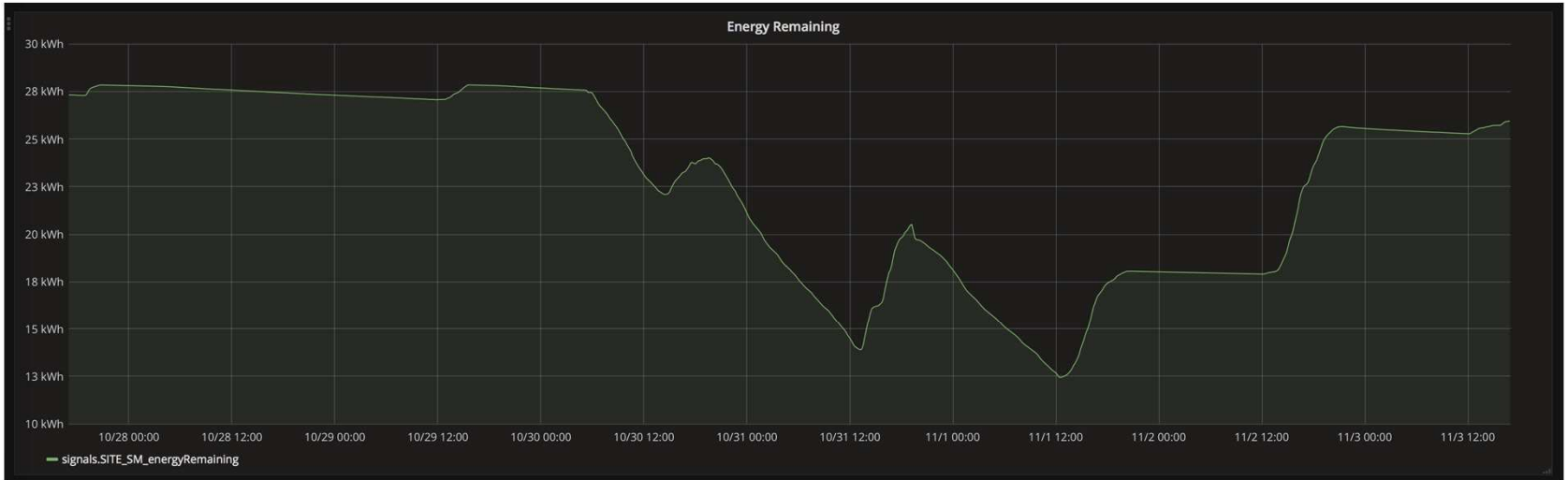
Tesla PowerWall 2

- Tesla Powerwall 2
  - 13.5 kWh battery
  - “Daily cycle” can be cycled 5,000 times
- Ratings
  - 5.8 kW continuous (7 kW peak)
  - Can be mounted indoors or out
- GMP ordered 2,000 units
- $15/Month Rental (w/ GMP control)
- During an outage, can be charged with customer’s own solar

Discharging PowerWalls on Peak Day



PowerWalls & Reliability – 10/30/17 Windstorm



POWERPACK

TESLA COMMERCIAL BATTERY

Tesla PowerPacks at Panton

- Every Powerpack II contains:
  - 16 individual battery pods
  - 50 kW, 200-220 KWH
  - Onboard power electronics
    - Hundreds of sensors
    - Optimize performance across the array
    - Easy swapping at any time.
- 21 PowerPacks being installed
- Builds on Tesla Model S battery technology (1 billion miles driven)
- Panton goes into commercial operation 7/1/18
- Looking at future projects…

Tesla Gigafactory 1 - Nevada

Questions?