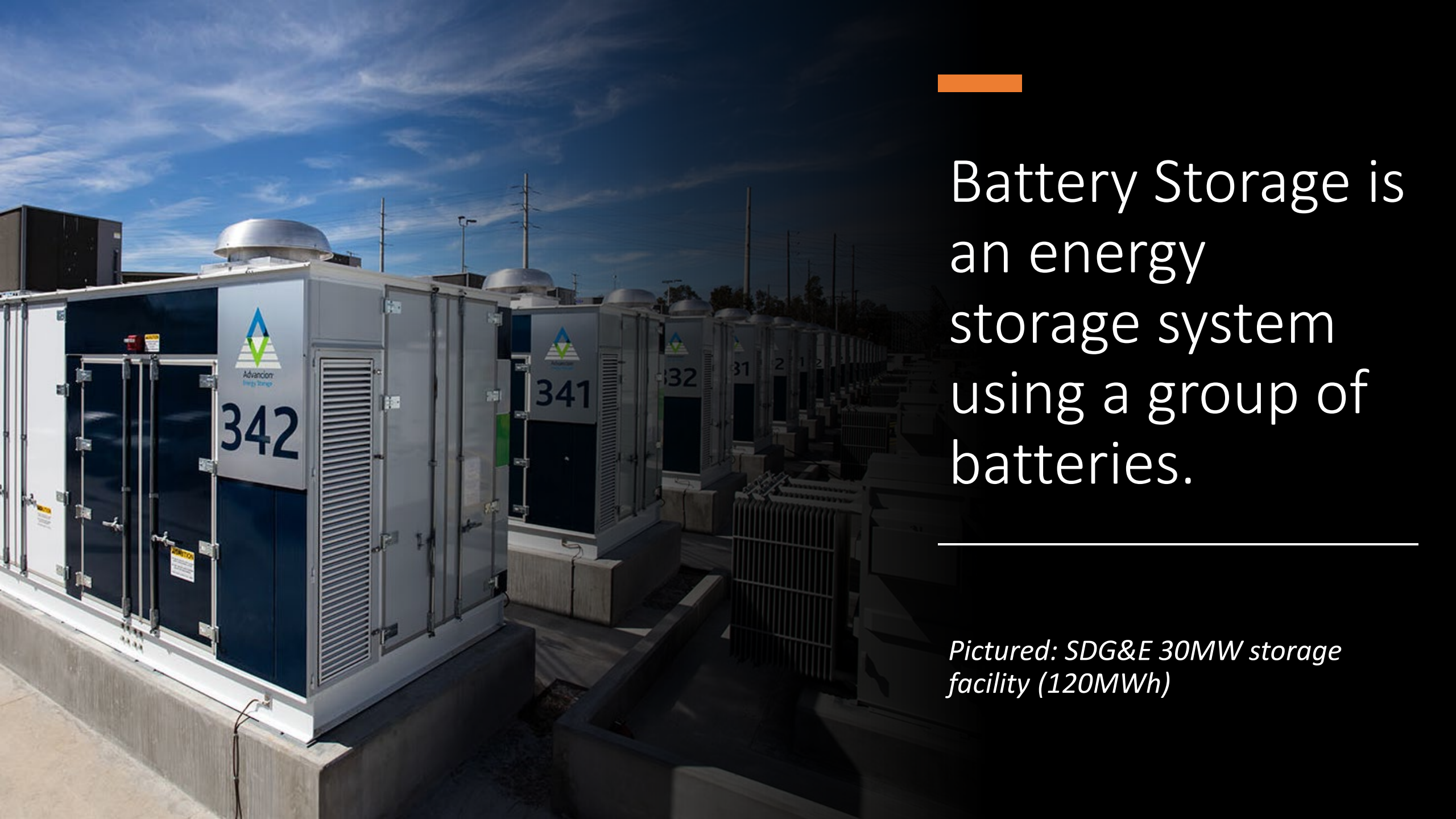


Battery Storage Systems

Yellowstone Valley Electric
Cooperative





Battery Storage is an energy storage system using a group of batteries.

Pictured: SDG&E 30MW storage facility (120MWh)

Why should one be installed?



Reduce peak demand charges



Increase reliability



Provide power delivery during maintenance



Other applications such as offsetting intermittent renewable generation and frequency response during voltage fluctuations

The logo for Yellowstone Valley Electric Cooperative features a stylized mountain range and a winding river within a circular frame. The text "Yellowstone Valley Electric Cooperative" is written in a bold, blue, sans-serif font with a slight shadow effect.

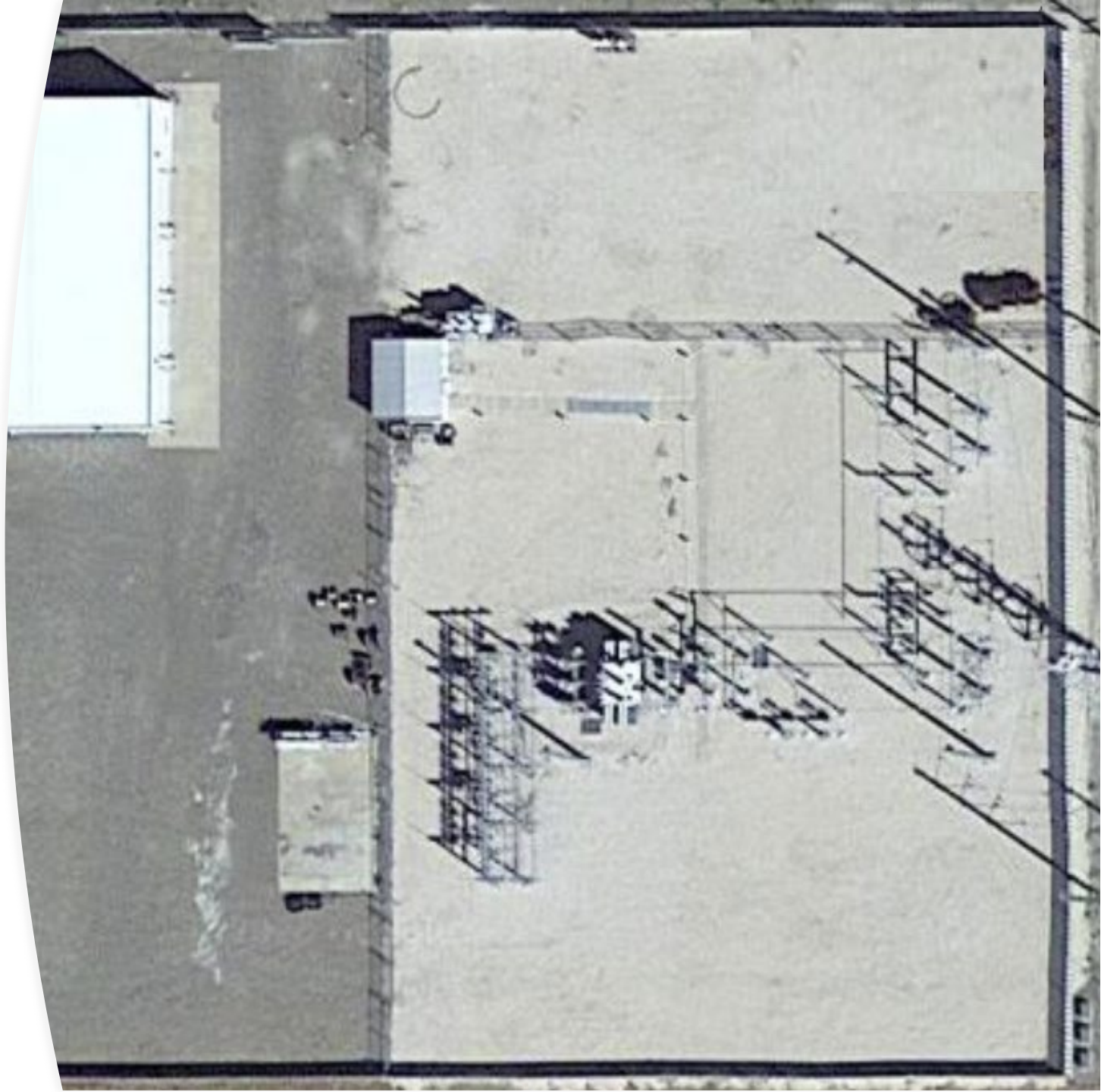
Yellowstone Valley Electric Cooperative

Why YVEC?

- For battery storage in an organized market based on costs, in order to provide capacity there would be a charge per kW. Basin has agreed to allow each G&T 150 kW per distribution member at no charge for capacity.
- CMT presides over 8 purchasing members with 7 of those members having rights to the above provision.
 - $7 * 150 \text{ kW} = 1.05 \text{ MW}$
 - CMT would like to isolate the battery storage capability to one member to save costs in development and utilize the savings across all of its members
- YVEC is a larger consumer of power in the member pool
- CMT passes through exact costs of kW/kWh from WAPA and Basin to YVEC
- CMT maximizes diversity to YVEC

Where will the battery storage be placed?

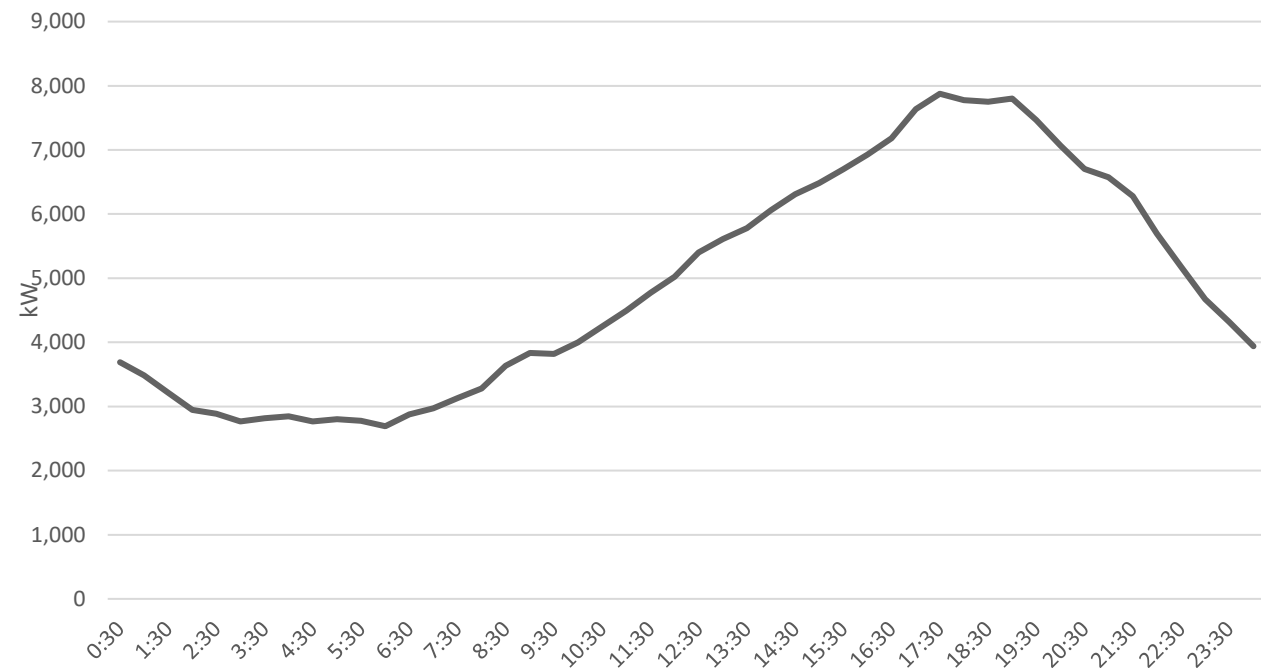
- YVEC's 72nd Street Substation has ample real estate within the substation yard to house the equipment
- 72nd Street Substation load is relative to peak loads seen by YVEC's system
- 72nd Street Substation has mostly residential loads allowing for a more consistent load throughout the year



YVEC loads

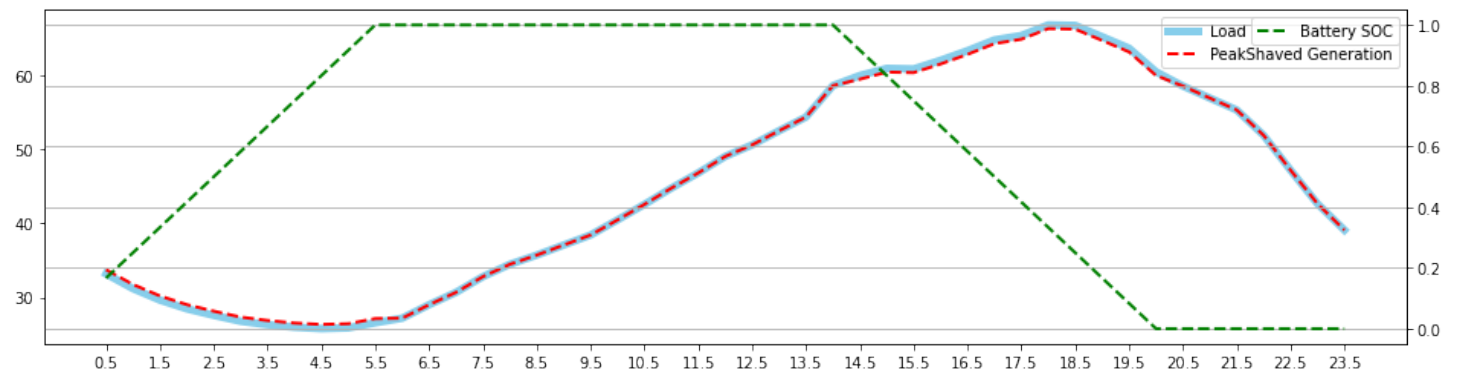
- Typical peaks occur between 2pm and 9pm
- Highest metered peak for 2019 was 66.794 MW
- On that day, 72nd St Sub peaked at 7,875 kW @ 5:30 PM
 - Approached 1 MW below peak around 3:30 PM & was lower than 1 MW below peak after 8:30 PM

72nd St Sub on July 23, 2019

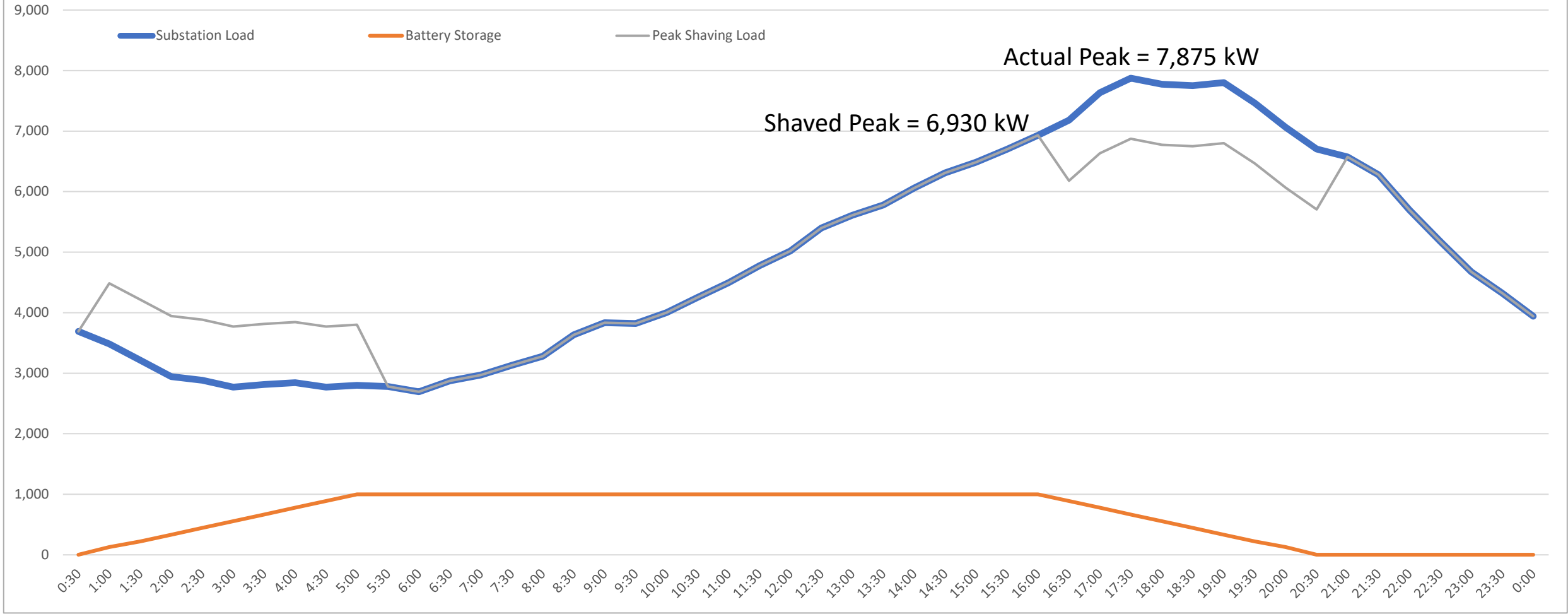


How will the batteries operate?

- An algorithm will learn system peaks at 72nd Substation each month
- Discharge will start when an expected peak is expected to occur during the designated peak windows based on historical load data
- When a peak has been established, the battery will not discharge until load is greater than the established peak for the current month
- Batteries will charge during non-peak hours



72nd St Sub on July 23, 2019



Battery Operation

Penciling out Costs

- YVEC is billed at \$19.64/kW for peak usage
- When YVEC successfully lowers their peak by 1 MW for a month, the total savings is ~\$20,000
- YVEC has communicated with a few different battery storage companies to realize the payoff periods for various battery arrangements

			Company					
Battery System			Company A		Company B		Company C	
Battery Size	Time Frame	Rated Capacity	Cost	Yrs to Payoff	Cost	Yrs to Payoff	Cost	Yrs to Payoff
250 kW	4 hrs	1 MWh	\$575,000.00	9.76	\$682,005.00	11.58	\$625,000.00	10.61
500 kW	4 hrs	2 MWh	\$1,150,000.00	9.76	\$1,064,689.00	9.04	\$1,250,000.00	10.61
1 MW	4 hrs	4 MWh	\$2,300,000.00	9.76	\$1,766,598.00	7.50	\$2,250,000.00	9.55

Questions

- How long does it take to charge the batteries?
- Will batteries lose charge sitting idle and not being discharged?
- Will the batteries be affected by weather?