

FEDERAL UTILITY PARTNERSHIP WORKING GROUP SEMINAR

May 2-3, 2019
San Diego, CA

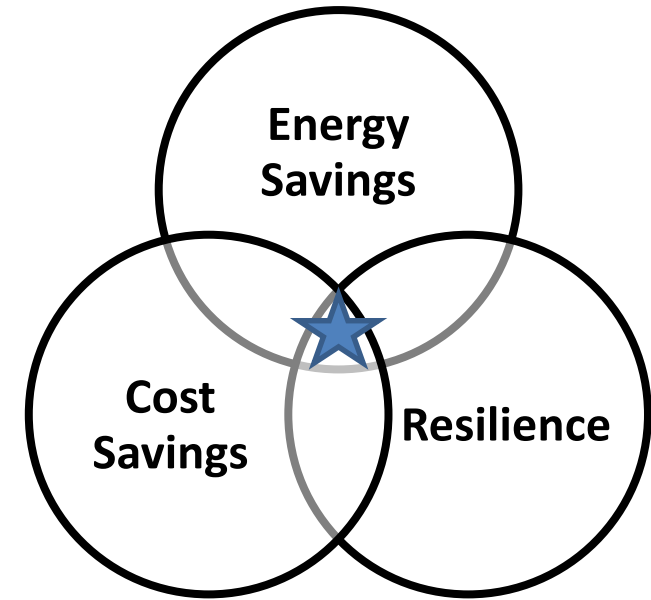
Energy Storage Economics
Emma Elgqvist, Research Engineer, NREL

Hosted by:



RE & Storage for Resilience

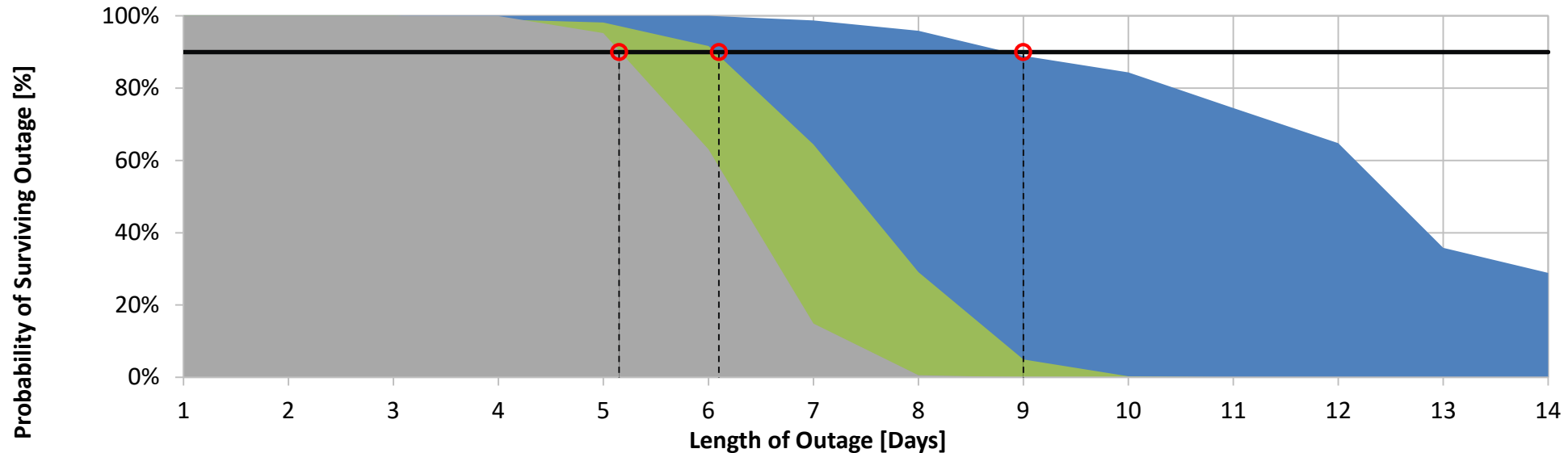
- RE + storage can increase survival time during a grid outage when fuel supplies are limited
- RE + storage can provide revenue streams and savings while grid connected
 - Savings may allow for the incorporation of additional microgrid components



RE & Storage for Resilience

In some cases, RE + storage can contribute to resilience goals *and* provide cost savings.

	<u>Generator</u>	<u>Solar PV</u>	<u>Storage</u>	<u>Lifecycle Cost</u>	<u>Outage</u>
1. Base case	2.5 MW	-	-	\$20 million	5 days
2. Lowest cost solution	2.5 MW	625 kW	175 kWh	\$19.5 million	6 days
3. Proposed system	2.5 MW	2 MW	500 kWh	\$20 million	9 days



Value Streams for Storage

		Service	Description	Grid	Commercial	Residential
Value varies	{	Resiliency / back-up power	Using battery to sustain a critical load during grid outages	✓	✓	✓
		Demand charge reduction	Use stored energy to reduce demand charges on utility bills		✓	✓
Utility Rate Structure	{	Energy arbitrage	Behind the meter: energy time-of-use shift (from on-peak to off-peak hours)		✓	✓
			Wholesale: buy during off-peak hours, sell during on-peak hours	✓	✓	
Utility/Regional Programs	{	Demand response	Utility programs that pay customers to lower demand during system peaks		✓	✓
		Frequency regulation and capacity markets	Stabilize frequency on moment-to-moment basis or supply spinning, non-spinning reserves (ISO/RTO)	✓	✓	
Transmission & Distribution	{	Voltage support	Insert or absorb reactive power to maintain voltage ranges on distribution or transmission system	✓		
		T&D upgrade deferral	Deferring the need for transmission or distribution system upgrades, e.g. via system peak shaving	✓		

Drivers for Grid-Connected RE + Storage Systems



**Storage
Costs**



**Incentives
& Policies**



**Utility Cost &
Consumption**

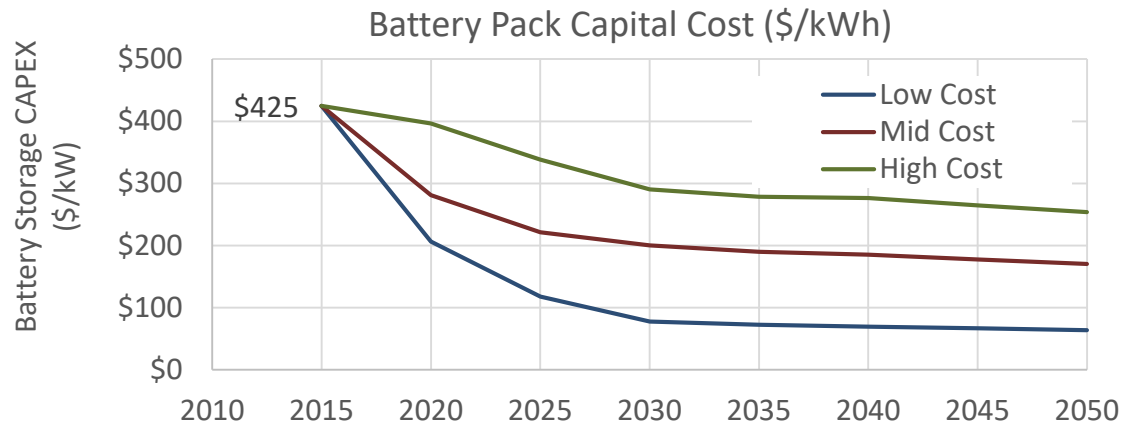


**Ancillary
Services
Markets**



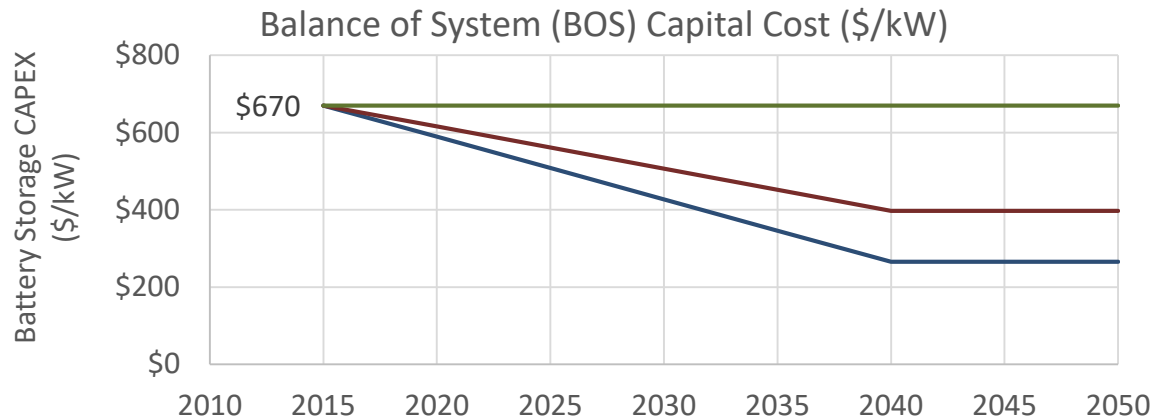
**Resilience
Goals**

Utility Scale Cost Estimates & Projections



Total System Cost

$$= \left(\text{Battery pack cost} \left(\frac{\$}{\text{kWh}} \right) * \text{Battery pack size (kWh)} \right) + \left(\text{Battery BOS cost} \left(\frac{\$}{\text{kW}} \right) * \text{Battery BOS size (kW)} \right)$$

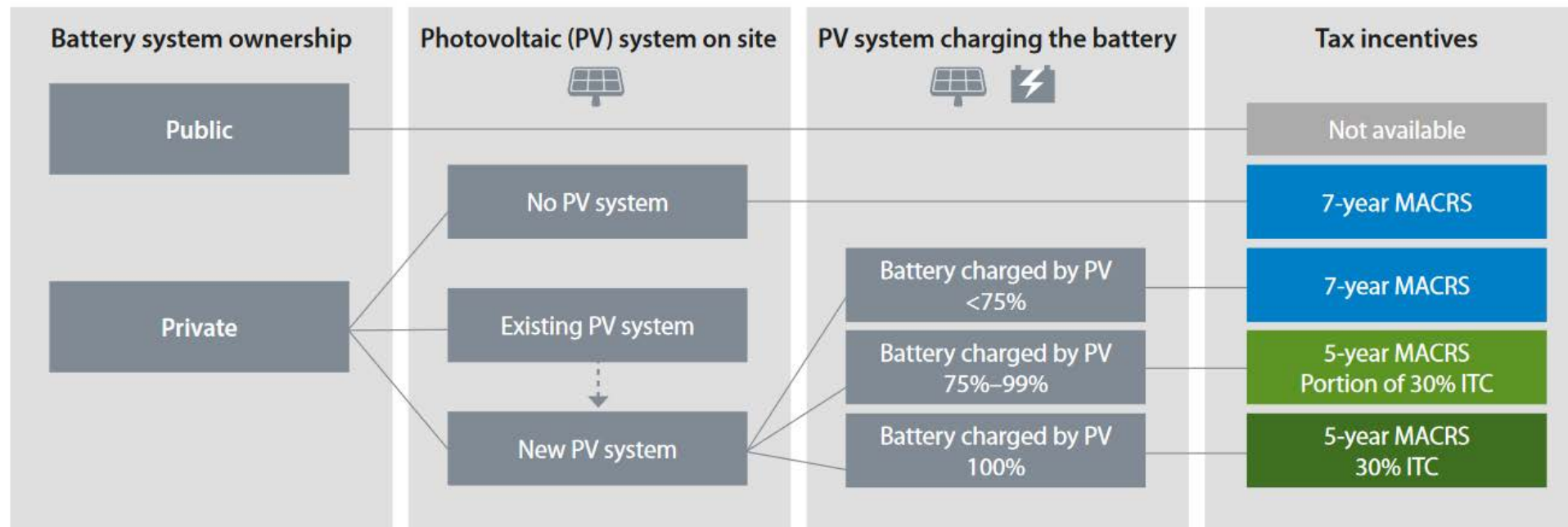


Example: 2015 2,000 kWh : 1,000 kW battery

$$\left(\left(\frac{\$425}{\text{kWh}} \right) * (2,000 \text{ kWh}) \right) + \left(\left(\frac{\$670}{\text{kW}} \right) * 1,000 \text{ (kW)} \right) = \$1.52 \text{ MM}$$

Incentives for Storage

Federal Investment Tax Credit (ITC) for storage: Lowers the cost of storage when coupled with RE.



State incentives for storage: state incentives, like the CA SGIP, can significantly accelerate the deployment of storage.

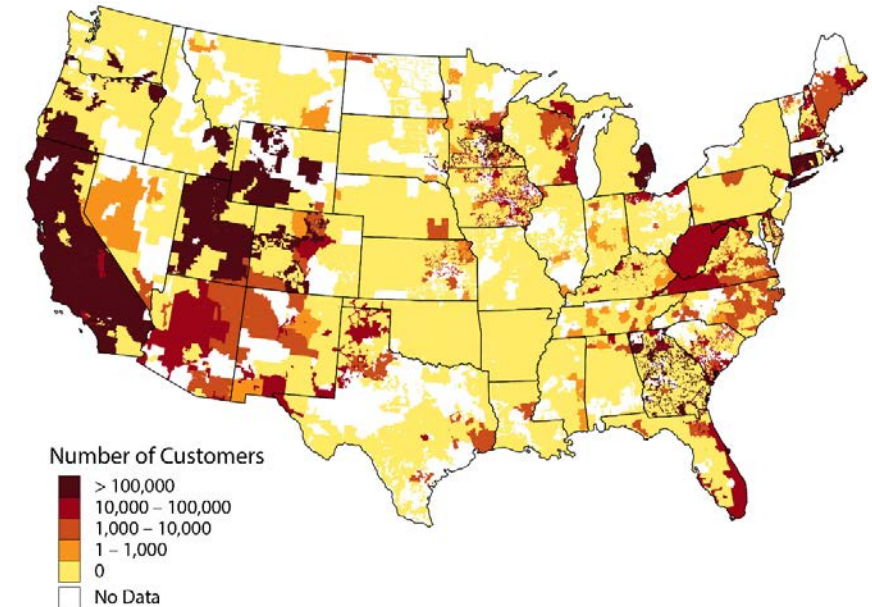
State net metering policies: in states with net metering policies, storage can be less impactful.

Electricity Bill Structure

Electricity Bill Component	How It's Billed	How Storage Can Help
Energy Charges	Amount of kWh consumed (can vary by time of use [TOU])	Shift usage from high TOU periods to low TOU period
Demand Charges	Based on highest demand (kW) of the month	Reduce peak demand when dispatched during peak period
Fixed Charges	Fixed cost per month	Storage cannot offset these

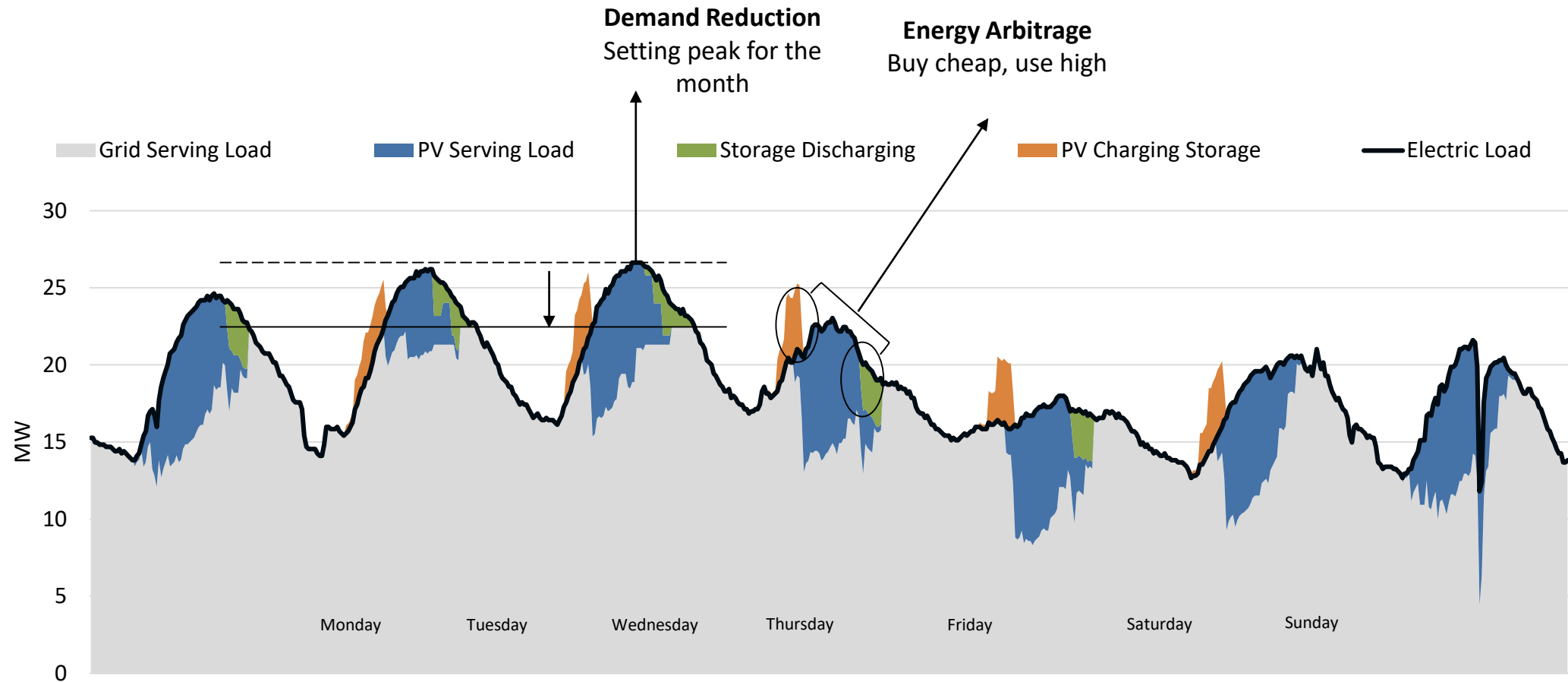
Other types of charges include:

- Minimum charge
- Departing load charge
- Standby charge
- Power factor

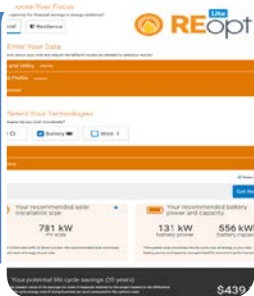


Number of commercial customers who can subscribe to tariffs with demand charges over \$15/kW

Load Shape



Resources for Storage



REopt Lite

Tool to evaluate RE + storage opportunities at your site

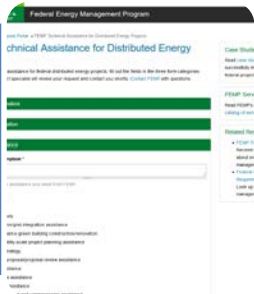
<https://reopt.nrel.gov/tool>



Factsheet

Considerations for implementing PV + storage at federal sites

https://www.energy.gov/sites/prod/files/2018/08/f55/pv_plus_storage.pdf



FEMP TA Portal

Technical Assistance for federal agencies

<https://www7.eere.energy.gov/femp/assistance/>

Thank You!
Emma Elgqvist
emma.elgqvist@nrel.gov

