FEDERAL UTILITY PARTNERSHIP WORKING GROUP SEMINAR

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Fort Carson Battery Energy Storage System

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Hosted by:

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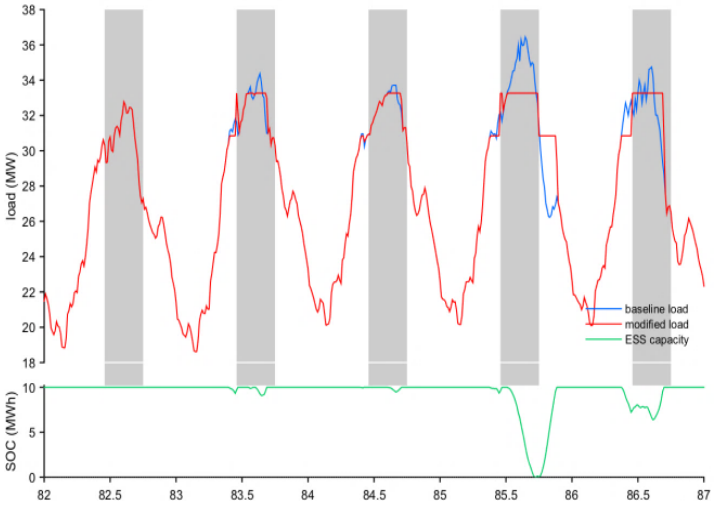
Introduction

- What is a BESS?
- Demand Savings
- Why Fort Carson?
- Considerations for Design
- Project Economics
- Utility Impacts and Teaming
- Construction
- Things to Consider
- Other Use Cases

Battery Energy Storage System

- What is a BESS?
  - Battery: Cells – Modules – Racks – Enclosure
  - Battery control systems, safety devices, system cooling and support
  - Inverters, bi-directional transformers, protective devices, point of common connection
  - Charge/discharge control, communications
- Resilience Benefits

Using A BESS for Peak Shaving
(Demand Charge Management)



- Demand based on monthly maximum
- Tariff supports opportunity for savings
- Demand profile is shave-able
- Consider both Power and Energy
  - Maximum discharge rate (in kW) – determines max savings
  - Total battery capacity (in kWh) – enough to achieve savings
- Capacity must last through the entire peak
  - Savings most often capacity limited

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Using A BESS for Peak Shaving
(Demand Charge Management)

- Dumb Battery – no discharge control
  - Low power (savings) to energy (cost) ratio
  - Not economically viable
- Smart Battery
  - Decrease capacity, increase discharge rate
  - Requires predictive control for real time use
  - Increases savings risk

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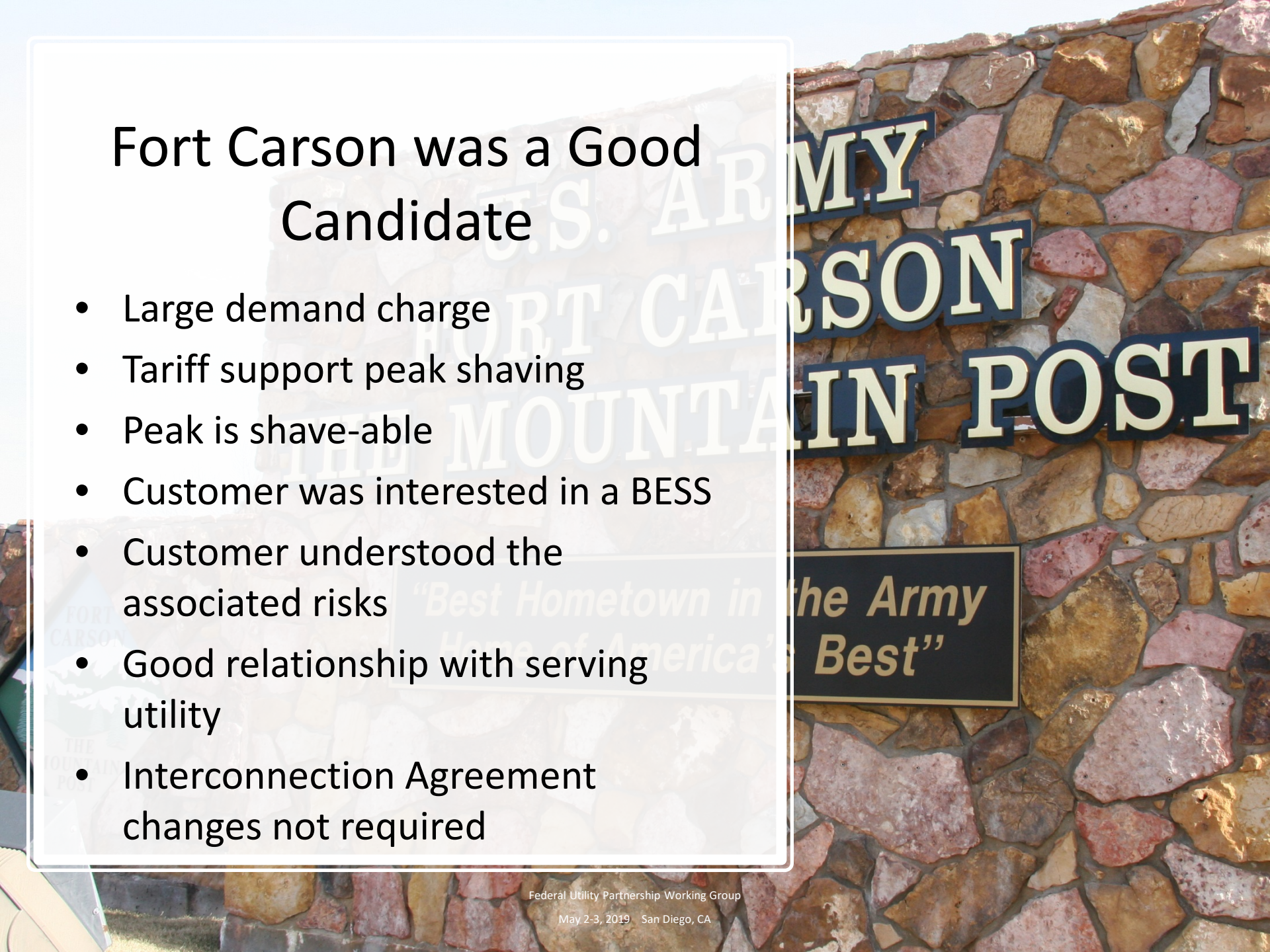
Fort Carson was a Good Candidate

- Large demand charge
- Tariff support peak shaving
- Peak is shave-able
- Customer was interested in a BESS
- Customer understood the associated risks
- Good relationship with serving utility
- Interconnection Agreement changes not required



Fort Carson was a Good Candidate Cont'd

- Also
  - Fort Carson DPW has an appetite for innovative projects
  - 8 MW of existing Solar PV, going to 15 MW
  - Existing infrastructure capacity

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Challenges

- Must be a smart battery
- 6 separate meters aggregated to 1 bill
  - Must monitor all 6 in real time
- Contribution from external supply (WAPA)
- Seasonal Impacts
- Solar introduces profile variability

System Design Considerations

- Detailed analysis of historical data
- Survey of market participants
  - Offerings must match project needs
- Communications between components
- Redundancy, limit single points of failure
  - Risk mitigation
- No export to utility
- Remote substations

Partners

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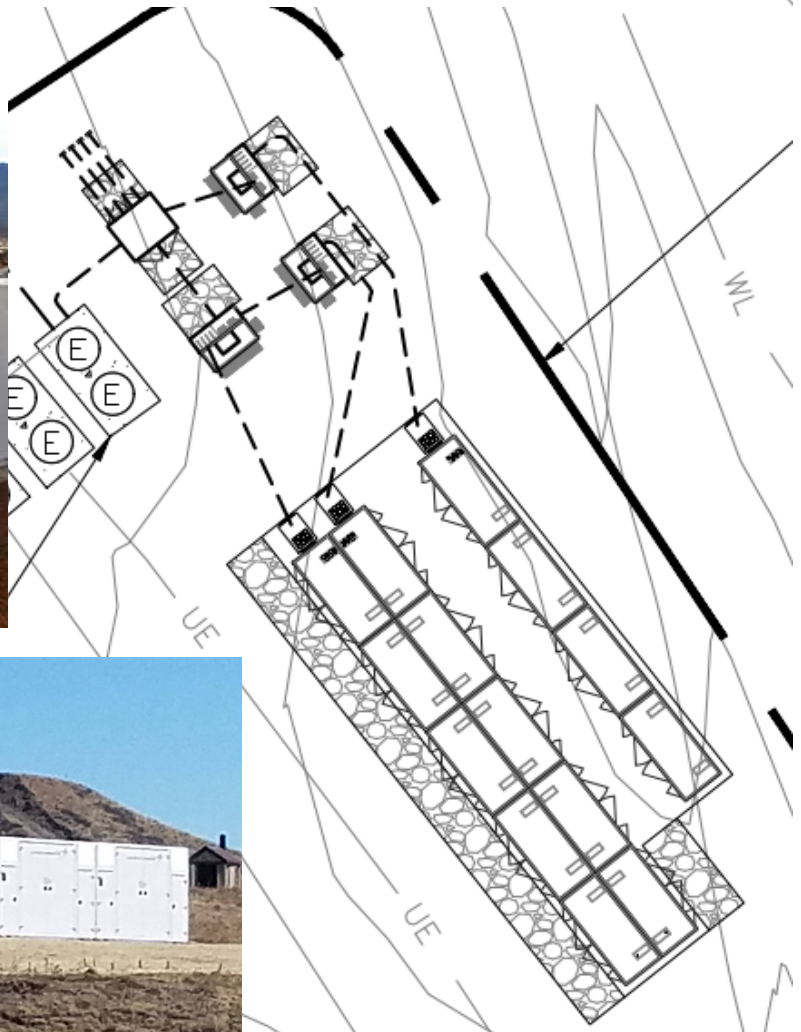
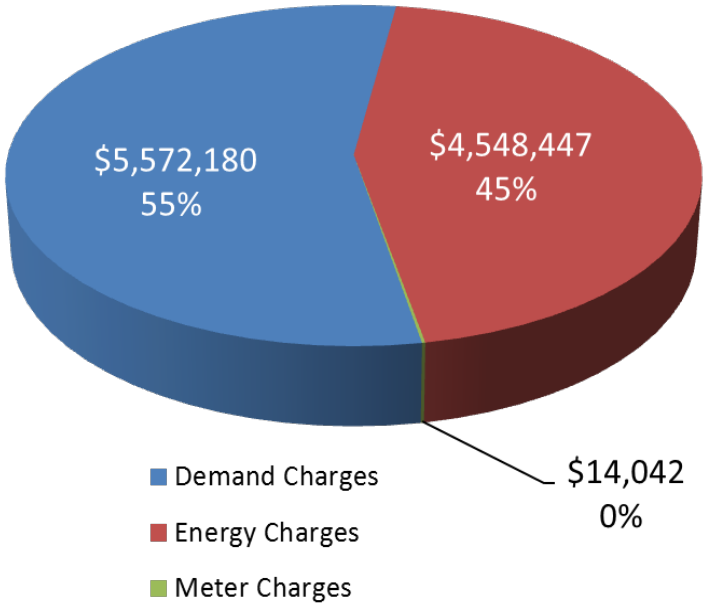
It's how we're all connected

System Overview

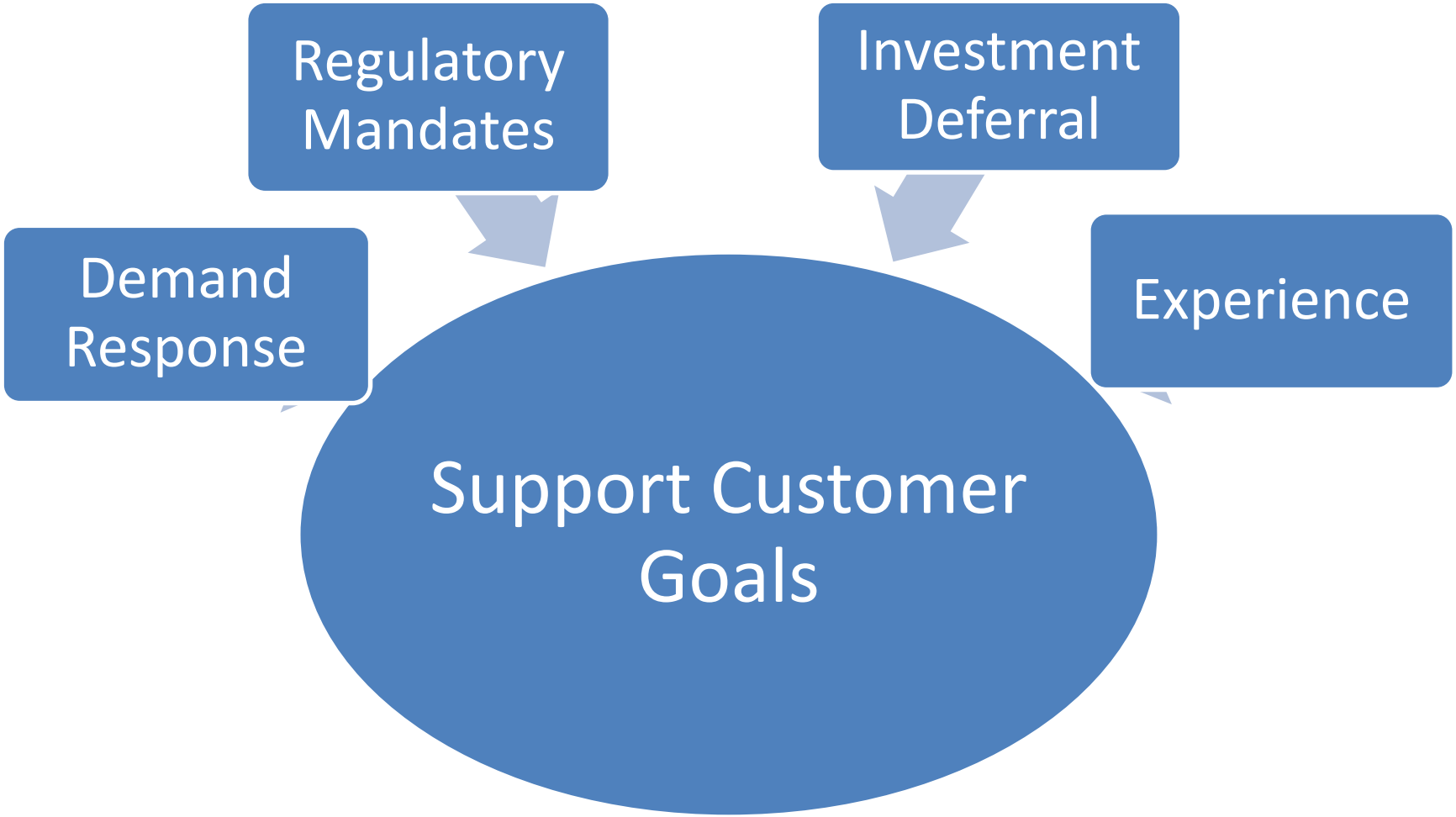


Economics

- Demand is 55% of Fort Carson's electric Bill
- DCM will result in $525K in annual savings
  - Need to capture about 3,200 kW a month
- ESUs 70% of cost, BOS and installation made up remaining 30%
- ~90% efficient
- No time of use shifting opportunity
- Complete package payback under 20 years
  - Includes performance period costs and financing



Utility Interest in Behind-the-Meter BESS



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Fort Carson BESS Installation

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Fort Carson BESS Installation

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Things to consider

- Application very specific to situation
- Importance of historical data
  - Analysis & design
  - Power & energy requirements
  - Duty cycle (impact to system degradation)
- Tariff/savings methodology
- Match use case to economics
- Existing/planned distributed generation resources
- Interconnection agreement
- Cyber security

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Things to consider, continued

- Stakeholder engagement
- Understand/share the risk
  - Customer must understand risks
- Details
  - Understand how savings will be achieved
  - Understand impacts to load profile
  - M&V (Demand reduction guarantee)

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Other Economic Use Cases

- Equipment upgrade deferral
- Power factor correction (VAR support)
- Equipment substitution
  - Frequency control
  - Solar firming/ramp rate control
  - Voltage regulation
- Demand response
- Time-of-use shifting

Questions?