SOLAR + BATTERY STORAGE: APPLICATIONS AND SOLUTIONS FOR MICROGRIDS

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Introduction

Utilities around the country are looking for affordable solutions to improve reliability in their networks, particularly when looking at the remote and most distant parts of their distribution networks. A microgrid, solar + battery storage facility is one solution to an expensive second circuit for a network.

Analysis

Solar and energy storage are being embraced by large utilities, solar developers, businesses, municipalities, residential neighborhoods, alike. The reduced cost and accessibility has led to steady industry growth over the past few decades. Solar + battery storage offers reliability to customers - although solar only generates power through sunlight, battery storage can fill the gap. Energy storage can be sized and priced according to need, through proper engineering it allows for safe and reliable back up, can be used to offset load when rates are high, and smart controls can be applied to perform automatic switching, when the solar generation source isn't at it's peak.

These microgrid, solar + battery storage projects have some unique designs and challenges, including the need for flexible modes of operation, robust fire protection systems and careful considerations of equipment and build locations.

The arrangement and mounting of solar panels will also affect your production and installation costs. Tracking systems can help to optimize acreage, but may take more time to install than a fixed tilt system. All of these considerations are made when designing and building a solar and battery system for individual project needs and power demands.

Pre-Design and Development Considerations

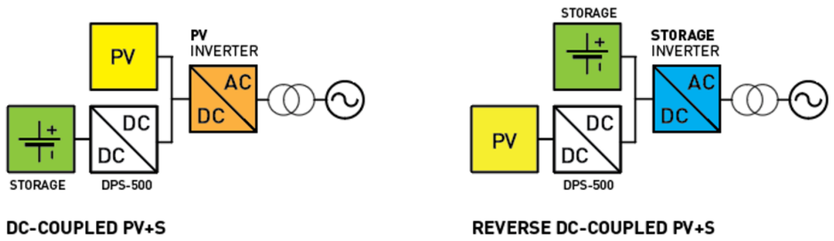
When Considering this Application, Location is Key!

When considering a location for a solar + energy storage microgrid facility, utilities, developers, and IPP's need to note that difference states/cities may have varying fire safety requirements and that the interconnections can vary, as well.

Ideal location characteristics include:

- An open space abundant with sunlight
  - Void of nearby trees or ensure vegetation removal to eliminate PV shading
- Easy interconnection point
- Good, buildable land with adequate civil infrastructure
  - Adequate drainage, no ponding, little required grading
- Larger available area - More space, more panels

Allow for oversizing DC (High DC to AC Ratio)



There are multiple ways to bring the DC power of solar to AC power on the grid, each with their own advantages and disadvantages. DC coupled systems can increase efficiency of power transfer between solar the battery while AC systems provide design and control simplicity.

Flexible Modes of Operation, through a Solar + Battery Storage Solution

- Activation - Standard start up and operation routine
- Blackstart - When incoming power is not available, system is capable of self starting to provide power
- Optimization - Economic, PV Smoothing, PV firming, Power Quality, Reverse Power Flow Mitigation, Battery SOC Management, Optimizing Modes
- Islanding - Intentionally starting power production when incoming power is lost

Design Considerations

Equipment

- Wire management (CAB system, integrated tracker wire management)
- Type of modules (mono-facial vs. bifacial)
- Panel arrangements (1P, 2P, 2L)
- Racking (Fixed-tilt vs. tracker)

Tracker Placement

- Orientation based on geo-location
- Trackers may require wireless communication; interference can occur between antennas if there's obstructions
- Limits to how many panels fit a single tracker

Collection Systems

- String level inverters vs larger central inverters
- Wire management – Keeping wire runs as short as feasible to reduce potential losses
- Major equipment location relative to interconnection

This image shows how the bi-facial modules on a 2L tracker are not experiencing "rear-side" shading from the torque tube. Not the shadows to the right are in a 1P orientation and refracted light from the ground would be blocked by the torque tube.

Robust Fire Protection Systems

- You must be considerate of local codes and standard
- May require a permanent fixed water supply
- Chemical fire suppression may not be enough protection

Understand your Basic Battery Technologies

Basic Battery Technology	Pro	Con
Lithium-ion	Energy Dense	Flammable when they Fail
Aqueous Zinc Battery (Zinc-ion)	Non-flammable	Less Energy Dense
Mechanical Energy Storage	Ideal for Remote Applications	Not Energy Dense