



Hybrid resources consist of multiple types of generation technologies at a single point of interconnection that operate in the market as a single resource. Typically battery storage paired with solar, hybrid resources offer greater controllability of variable resources, increasing their resource adequacy value and offering operational benefits.

## Solar and Storage Share Unique Synergy

While the hybrid model can apply to any type of generation, renewable or traditional fuel, the most common pairing for hybrid resources in PJM is solar and battery storage.

Solar and storage share a synergy: Both make similar use of inverters to convert energy from direct current (DC) to alternating current (AC), which is used on the grid.

Hybrids accounted for about 27,000 MW of capacity in the PJM interconnection queue at the end of 2023, signaling a trend for the region and reflecting a nationwide resource shift.

Across the country, a number of factors are driving these projects, including the declining cost of batteries and solar technology, individual states' efforts to reduce greenhouse gas emissions, the availability of potential federal tax credits, and the various economic efficiencies of sharing the same site, interconnection and permitting costs, and equipment.

## A Hybrid Represents One Generation Resource

In some cases, the battery component may be able to charge from the grid, which is known as an "open loop." In others, it charges from its paired generation source only, known as a "closed loop."

Hybrid resources are modeled as a single resource for the purpose of offering into PJM's capacity, energy and ancillary services markets.

## Process Underway To Facilitate Hybrid Integration

PJM and stakeholders have been working together to amend PJM's governing documents and business practice manuals to ensure hybrid resources have clear business rules to guide their participation in the markets. PJM's Phase I rules for hybrid resources, focused on basic concepts and solar-plus-storage hybrids, became effective June 1, 2023. Phase II reforms focused on different technology combinations and the potential to optimize market offers from individual resources within a mixed technology facility. They went into effect Nov. 1, 2023. Since then, PJM and stakeholders have been working on enhancements to existing rules under Hybrids Phase III.

While hybrid resources can currently operate in PJM's energy, capacity and ancillary services markets, very few are currently operating as such in these markets. Enhanced governing document provisions and business rules ensure PJM's markets are able to accommodate the expected growth in this emerging resource class.

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### Key Points

- Hybrid resources consist of multiple fuel types behind a single point of interconnection, typically generation and energy storage, and operate in the market as a single resource.
- Batteries combined with wind or solar generators help firm the output of these variable resources.

