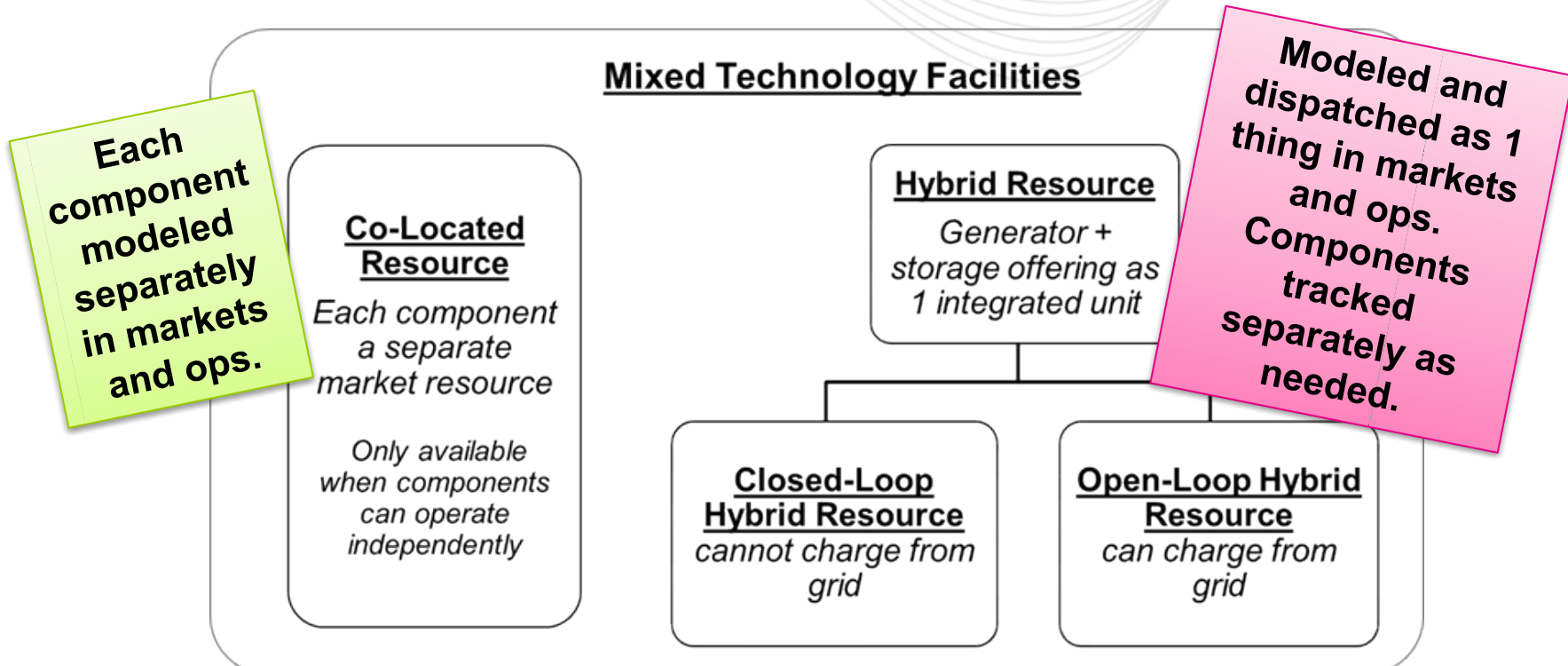




Hybrids Phase II Solution Package Proposal

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- Hybrids issue charge approved June, 2020, with aim to clarify market participation for tens of thousands of MW of mixed-fuel queue positions (mostly solar+battery).
- Hybrids Phase I focused on solar-storage hybrids, with some minor provisions for other types of hybrids .
 - *Phase 1a (classification and metering) is currently implemented, with manual language effective October 1, 2022*
 - *Phase 1b (energy market model) is targeted to go live June 1, 2023*
- **Hybrids Phase II encompasses other hybrids (e.g., wind+solar, etc).**
 - DIRS produced the present package proposal for consideration of standing committees. *The package requires Tariff changes.*
 - Manual revisions for Phase II to follow FERC approval.



“Hybrid Resources may participate in markets according to the following provisions in this section 1.4C, as further detailed in the PJM Manuals.”

1. Broaden definition of “Hybrid Resource” from 1gen+1storage to any number of different types of gen (with or without storage).
 - The implication is that more resource types (e.g., hydro+solar, gas+solar, etc) inherit the “Hybrid Resources may participate in markets” provision from phase I.
2. Detailed energy market model for inverter-based hybrid resources:
 - Broaden applicability of the solar+storage energy market model to all inverter-based storage hybrids (e.g., wind+storage, wind+solar+storage, etc).
 - Inverter-based gen-only Hybrid Resources (e.g., wind+solar) use similar energy model as wind.
3. Clarify expected ECOMAX parameter from inverter-based hybrids (and standalone storage), and corresponding uplift rules.
 - *E.g., a solar+wind hybrid is not eligible for lost opportunity cost payments in excess of the wind+solar backcast, even if bid-in ECOMAX were higher.*

- Variable+battery hybrid ECOMAX should not exceed `battery_nameplate_MW` plus `anticipated_variable_availability` when the battery is not empty
 - “Variable” type component = wind, solar, intermittent hydro, etc.
- Variable+battery hybrid ECOMAX should not exceed anticipated variable availability when the State Of Charge of the battery component is at or below the Minimum State Of Charge (i.e., it is empty), or if there is no battery (e.g., wind+solar hybrid).
- ECOMAX of an Energy Storage Resource Model Participant should not exceed 0 when the State Of Charge is at or below the Minimum State Of Charge (i.e., it is empty).

- To the extent that the parameter of a hybrid resource or standalone battery resource does not properly reflect the unit's capability, PJM reserves the right to limit lost opportunity cost (LOC) payments to the more accurate parameter value.
 - E.g., a Variable+storage hybrid with non-empty battery (i.e., State Of Charge value is greater than Minimum State Of Charge parameter) has LOC limited to the variable(e.g., wind or solar) backcast plus battery_nameplate_MW
 - E.g., a variable+storage hybrid with empty battery (or no battery, or in variable-only mode) has LOC limited to the variable backcast (e.g., wind or solar, or wind+solar in case of wind+solar hybrid)
 - E.g., an empty battery has LOC limited to 0 MW
 - A resource has LOC limited to Maximum Facility Output

- Design Component 0a: the Maximum Facility Output at a Mixed Technology Facility shall be fully allocated to its component Co-Located Resources. This allocation effectively sets the Effective Nameplate Capacity (ENC, input to calculation of UCAP) of a Co-Located Resource that is a renewable or storage resource.

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