



Hybrid Generation Resources

Market Roadmap ID: IR086

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Market Subcommittee (MSC)

June 10, 2021



Purpose & Key Takeaways

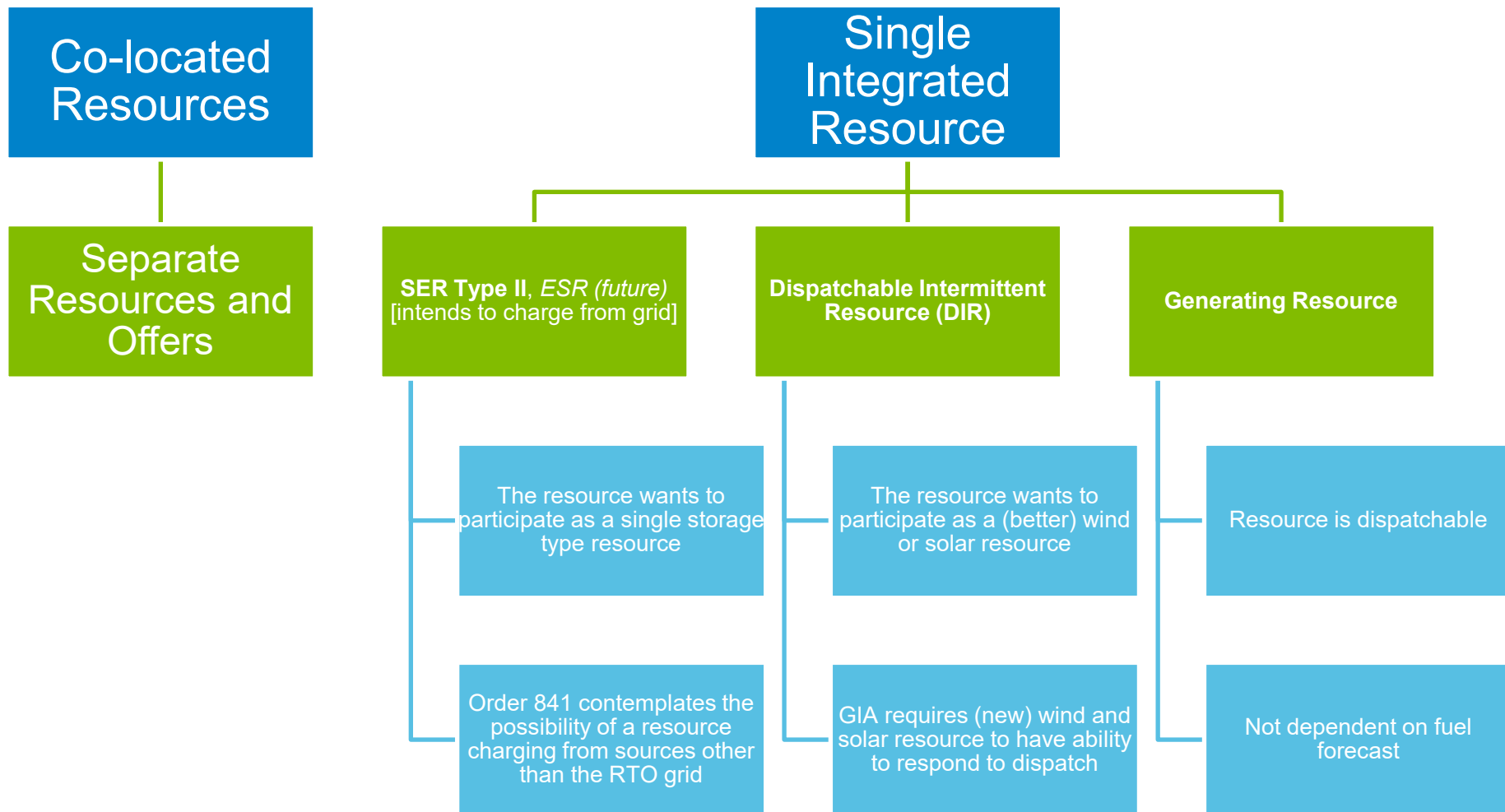


Purpose: MISO Response to Stakeholder Feedback and Priorities

Key Takeaways:

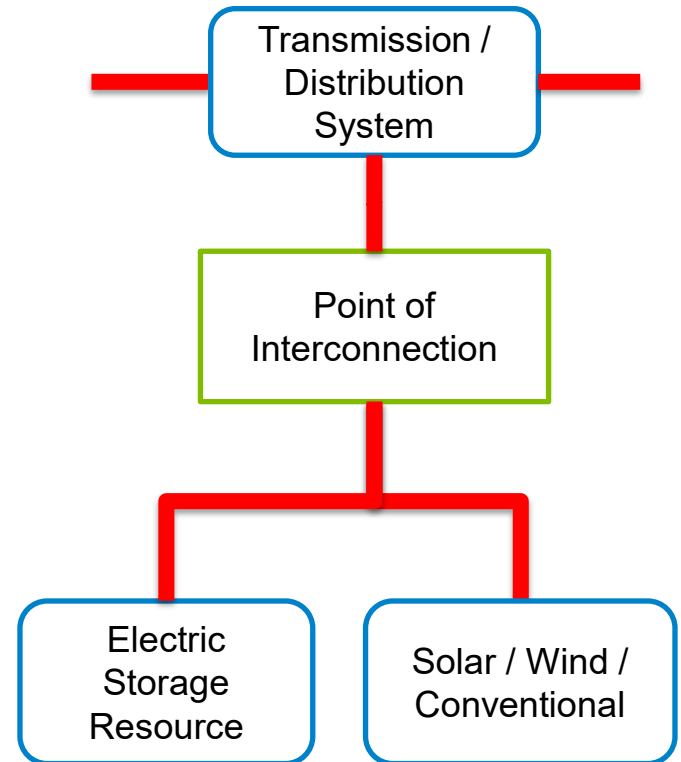
- Stakeholder feedback helpful for examination of hybrid resource
- Some priority requests can be accommodated short-term
- Others require more discussion and longer implementation timeframe
- Upcoming hybrid workshop: June 21

Hybrid Resource with Storage Registration Options



Co-Located Resources are not Hybrid Resources

- A Market Participant may register two separate resources behind the same point of interconnection
 - MISO considers these co-located resources and not hybrid resources
 - Total interconnection managed by market participant through offers
 - No current barrier to participation in MISO markets



Stakeholder Feedback

Enhancement Suggestions

- Allow hybrids to operate like a gas plant
- Add hybrid specific measurement and verification
- Existing models ok in near term (incorporate ASAP)
- Choose multiple options / switch between
- Reasonable and feasible fuel forecast verification
- Provide flexible options / remove barriers
- Hybrid resource operating guidelines for certainty
- Adjust DIR to include Regulation Up
- Primary Frequency Response and Reactive Power Support as new market products
- Additional compensation for fast ramp rates
- Market compensation for non-wires transmission alternative resources
- Flexibility in grid operation and market parameterization

Feedback Review

Question	Response
Benefit to hybrid generators with no storage?	Share interconnection rights and costs. Likely project specific.
How will solar+wind in queue operate?	Likely modeled as a DIR based on forecast dependence.
Separate definition for co-located?	Existing tariff covers these resources
How to retire a portion of a hybrid?	Follow standard process like derating a regular generator by submitting an Attachment Y request.
Transmission charges for grid charging?	MISO to follow Order 841 (ESR) guidelines. May require tariff change.

Feedback Review Continued

Question	Response
Implications of operating as SER Type II and ESR, et al? [performance, forecasts, product eligibility, charging options, MWP]	Subject to existing benefits/limitations. Choose option that best meets intended operation.
Dispatch when operating individually or as a combined asset?	Cleared and dispatched by market based on offers including offer limits.
ESR allow charging from other resources and grid?	Yes, MP is responsible for accounting for the charging.
Can MISO provide a forecast for hybrid as DIR?	No, resource must provide its own forecast
For hybrid as DIR, does MISO see storage/renewable interactions?	Not for market purposes but may require data from each type of device for visibility.
For hybrid as DIR, what incentive to use MISO forecast?	Resource must provide its own forecast.

Helpful Feedback on Proposed Definition of Hybrid Resource

- Originally proposed working definition:
 - “A Generation Facility that has multiple energy production devices that have more than one Fuel Source and participates in MISO Markets as a single asset with Interconnection Service that may be less than the total Generating Facility Capacity.”
- Feedback
 - Explicitly include storage (and other generator types)
 - Fuel type/source - clarification – elimination
 - Capacity \leq Interconnection – covered elsewhere / not necessary
 - ‘Operating as a Single Asset’
- Revised definition:
 - “A Generator that combines more than one type of Electric Facility for the production and/or storage for later injection of electricity.”

Stakeholder Near-Term Priorities

Stakeholder near-term priorities for hybrid market participation

Prioritization

#1	(SER Type II and Generator)	Expand intra-hour offer update flexibility based on DIR Forecast Maximum Limit
#2	(DIR)	Clarify that existing DIR Forecast Maximum Limit processes will account for storage operation of DIR-hybrids
#3	(Generator)	Refrain from imposing a “forecast independence” requirement.
#4	(DIR and Generator)	Clarify that hybrids may use virtual demand bids to schedule grid charging in Day Ahead and evaluate reliability implications
#5	(All Models)	Enable Ramp Rate offers for both individual components and the combined hybrid.
#5	(All Models)	Clarify partial outage capabilities/registration updates
#5	(SER Type II)	Confirm/expand market product and make-whole payment eligibility

Priority #1: (SER Type II and Generator) Expand intra-hour offer update flexibility based on DIR Forecast Max Limit

- **Problem statement/Rationale:** “While hybrid resources are highly flexible, their behavior in one time period can influence their availability in subsequent periods, and that activity may not be predictable in the DA market. The full capability of these resources may not be able to be offered into the DA market due to these realities. Therefore, realizing the full value of these resource in the market will require the ability for Market participants to update their offers as close to the dispatch interval as possible such that offers reflect the full capabilities of the resource. MISO should expand 5-minute Energy offer updates to the SER Type II and Generator Models, based on the existing DIR Forecast Maximum Limit functionality due to its usability.
- **MISO Response:** Not possible at this time given scope of change near-term software limitations. In the near-term, Participants can use current RTOE capabilities. MISO is interested in exploring this longer-term (not limited to hybrid, could be useful for DIR/ESR/Hybrid).

Priority #2: (DIR) Clarify that existing DIR Forecast Maximum Limit processes will account for storage operation of DIR-hybrids

- **Problem statement/Rationale:** “The storage component of DIR-hybrids will modify their Energy output relative to the forecasted value of a stand-alone DIR. MISO should clarify that DIR-hybrid resource owners can submit their own Forecast maximum Limit that accounts for this operation, and to automatically switch to the MISO forecast if the MP stops submitting its own forecast, which is the status quo. MISO should apply existing excessive and deficient energy threshold rules for stand-alone DIRs to DIR-hybrids.”
- **MISO Response:** MISO will not provide an hourly or 5-minute forecast for hybrids. Hybrids choosing to participate as DIR will be required to submit an hourly offer day-ahead and real-time offer with a forecast/EcoMax for day-ahead clearing and real-time commitment. Hybrids will also be required to submit a 5-minute forecast for real-time dispatch. When a 5-minute forecast is not submitted, MISO’s State Estimator MW would be used for dispatch target (abnormal state).
- Benefits of using the MISO forecast (waive penalties) would not apply to DIR-hybrid resources.
- *TBD: Forecasts for intermittent components of hybrids may still be required for visibility.*

Priority #3: (Generator) Refrain from imposing a “forecast independence” requirement.

- **Problem statement/Rationale:** “MISO should treat hybrid resources that choose to participate via the Generation Resource Model on a comparable basis to other generation resources. Hybrids using the generation model should not be subject to additional requirements, but rather have their commitments enforced by the same market penalties as other generation resources. Hybrid resources with a renewable component that seek to use the Generation model will be designed to emulate the operational behavior of a traditional generator. Their significant energy storage capacity will allow the resource to perform beyond the capability of the renewable component alone, and thus inherently do not “depend” on their renewable forecast to meet setpoint instructions based on their own market offers.”
- **MISO Response:** Leaning toward allowing this option with the caveat that the forecast independence appears feasible upon review of the hybrid design (e.g. must include storage, etc.). More work is required to figure out when this type of registration should be allowed. A tariff filing may be required to clarify DIR registration requirement for wind/solar fueled resources in combination with other generation resources.

Priority #4: (DIR and Generator) Clarify that hybrids may use virtual demand bids to schedule grid charging in Day Ahead and evaluate reliability implications

- Problem statement/Rationale : “The ability to charge a hybrid’s storage component from both the grid and paired resources will maximize their operational capability and flexibility and therefore value of these assets to the market. Energy storage charging from the grid is currently being accomplished without exposure to real-time pricing via virtual demand bids. This process also provides visibility to MISO for when, where and how much load will come onto the system for storage charging. MISO should clarify the allowance of hybrid resources to use virtual bids to schedule grid charging. MISO should also clarify the reliability benefit of doing so by clarifying inclusion of virtual demand bids in load forecasts used as an input into the RAC and Real Time market processes.”
- MISO Response: Conceptually, not limited by MISO’s tariff. Present use of this solution is applicable to a limited set of Market Participants. Allowing more widespread adoption would require further examination. Resources that want to charge from the grid may register each device as individual market participants (co-located) in order to provide the most flexibility for charging.

Priority #5a: (All Models) Enable Ramp Rate offers for both individual components and the combined hybrid

- **Problem statement/Rationale:** “Market participants should be able to offer the full ramping capability of the hybrid resource to the MISO market. Some market participation strategies will optimize multiple components into a single offer, while others will seek to offer specific capabilities from individual components of the hybrid resource at any given time. Existing market rules are largely sufficient for single-offer hybrid strategies (see further details other needed changes below). But clarification is needed on how an MP could submit offers for certain products from specific components of the hybrid. For example, how can a hybrid offer energy from its generation component with a given ramp rate, and Regulating Reserves from its storage component with a higher ramp rate?”
- **MISO Response:** Answer no, this is not a current or planned capability of the market and would be very difficult to achieve. If desiring independent ramp rates, the market participant can choose to offer as co-located resources rather than as a hybrid.

Priority #5b: (All Models) Clarify partial outage capabilities / registration updates

- Problem statement/Rationale: “Taking an outage on a component of a hybrid resource may limit the ability of the other component(s) still in operation to continue to participate in the market using the same participation model. Ensuring each available participation model can accommodate hybrids on partial outage or enabling more frequent opportunities to change registration would alleviate this concern.”
- MISO Response: 1. Partial outages can be managed as de-rate in CROW. 2. Registration updates for hybrids will be allowable within the normal registration cycle.

Priority #5c: (SER Type II) Confirm/expand market product and make-whole payment eligibility

- Problem statement/Rationale: "MISO should clarify the current capabilities of the SER Type II model and treat SER Type II hybrids on a comparable basis to other resources in the market by ensuring eligibility for appropriate make whole payments as well as market penalties for non-performance. There is limited experience with this model type and Market Participants seek additional clarity on the capabilities that can be offered by an SER Type II and any unique settlements implications, relative to other participation models available for hybrid resources. To the degree these limitations do exist, MISO should bring that information to stakeholders and take steps to remove identified barriers."
- MISO Response: No SER II changes will be considered because ESR is intended to replace SER Type II. MISO's focus will be on ESR implementation.

Stored Energy Resource Type II / Electric Storage Resource Comparison



	SER II	ESR
Multi-node	no	no
0.1 MW Resource Size	no	yes
Capacity	yes	yes
Energy	yes	yes
Reg	yes	yes
Spin / On-Line Supp	yes	yes
Off-Line Supp	yes	yes
Ramp Capability	yes	yes
STR	yes	yes
MISO Commitment	yes	Self-commit
MISO Dispatch	yes	yes
SOC Parameters	no	yes
MWP Eligibility	no	yes
Blackstart, Reactive Supply	no	yes
Offline Reserve Only Mode	with offers	yes

Hybrid Resources Workshop is scheduled for June 21

Hybrid Resources Market Participation Workshop will be held on Monday, June 21, 2021 9:00am – 12:00pm ET/ 8:00am – 11:00am CT

Conference Call / WebEx only

Meeting Information:

<https://www.misoenergy.org/events/hybrid-resources---market-participation---june-21-2021/>

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Appendix

Useful Links

- [FERC Staff Hybrid Paper](#)
- [AEE Hybrid Resources Webinar](#)
- [Berkley Lab ISO Queue Visualizer](#)
- [FERC Technical Conference](#)
- [Market Models and Forecasting for Hybrid Power Plants \(esig\)](#)

Module A Definitions

- **Dispatchable Intermittent Resource:** A Generation Resource whose Economic Maximum Dispatch is dependent on forecast-driven fuel availability.
- **Generation Resource:** A Generation Resource is a Generator within the MISO Balancing Authority Area or an External Resource that is Pseudo-tied into the MISO Balancing Authority Area and that (i) is registered to participate in the Energy and Operating Reserve Markets, (ii) is capable of supplying Energy, Capacity, Operating Reserve, Up Ramp Capability, Down Ramp Capability, and/or Short-Term Reserve, (iii) is capable of complying with the Transmission Provider's Setpoint Instructions and (iv) has the appropriate metering equipment installed.
- **Generator:** Any generating facility subject to the Transmission Provider's direction hereunder pursuant to either the Operating Protocol for Existing Generators, an IOA or an LGIA.
- **Resource:** Either a Generation Resource, Demand Response Resource-Type I, Demand Response Resource-Type II, Dispatchable Intermittent Resource, Intermittent Resource, Stored Energy Resource, Stored Energy Resource – Type II, or External Asynchronous Resource.
- **Stored Energy Resource:** A Resource capable of supplying Regulating Reserve, but not Energy, Contingency Reserve, Up Ramp Capability, and Down Ramp Capability through the short-term storage and discharge of electrical Energy in response to Setpoint Instructions.

Module A Definitions (Continued)

- **Stored Energy Resource – Type II:** A Resource either behind or in front of the meter capable of supplying Energy, Capacity, Spinning Reserve, Supplemental Reserve, Regulating Reserve, Up Ramp Capability, and/or Down Ramp Capability, through the storage and discharge of electrical Energy in response to Setpoint Instructions, including but not limited to negative dispatch levels, and whose State of Charge is managed by the Market Participant operating the Resource. A Stored Energy Resource – Type II shall be registered, modeled, offered and dispatched, as well as monitored and mitigated, as a Demand Response Resource – Type II, and shall use the Offer template for a Demand Response Resource – Type II, provided, that: (1) An SER – Type II will not be settled and compensated as a Demand Response Resource – Type II for any negative dispatch, and instead shall be treated as a regular Generation Resource for settlement purposes, except that an SER – Type II shall not be eligible for Day-Ahead Revenue Sufficiency Guarantee Payments, Real-Time Revenue Sufficiency Guarantee Credit, Real-Time Offer Revenue Sufficiency Guarantee Payment and Day-Ahead Margin Assurance Payment. (2) Reference Levels of SER – Type II shall be determined in accordance with section 64.1.4.a.i, 64.1.4.a.ii, and 64.1.4.b.i of this Tariff.

Attachment X Definitions

- **Generating Facility** shall mean Interconnection Customer's device(s) for the production and/or storage for later injection of electricity identified in the Interconnection Request, but shall not include the Interconnection Customer's Interconnection Facilities and shall not include a SATOA as defined in Module A. A Generating Facility consists of one or more generating unit(s) and/or storage device(s) which usually can operate independently and be brought online or taken offline individually.

FERC Approved Electric Storage Resource Definitions (June 2022)

- **Electric Storage Resource (ESR):** A Resource capable of receiving Energy from the Transmission System and storing it for later injection of Energy back to the Transmission System. This definition includes all technologies and/or storage mediums, including but not limited to, batteries, flywheels, compressed air, and pumped-hydro. The location of an ESR may be at any point of grid interconnection, on either the Transmission System or a local distribution system. An ESR must: (1) be capable of injecting and withdrawing a minimum of 0.1 MW; (2) be capable of complying with the Transmission Provider's Setpoint Instructions; (3) have the appropriate metering equipment installed; and (4) be physically located within the MISO Balancing Authority Area.
- **Electric Storage Resource Transaction:** Market Activities associated with the charging and discharging process of an Electric Storage Resource that consist of the withdrawal of Energy from the Transmission System, including any associated Energy purchases, and future injection of Energy, including any associated Energy sales, to the Transmission System under this Tariff.