

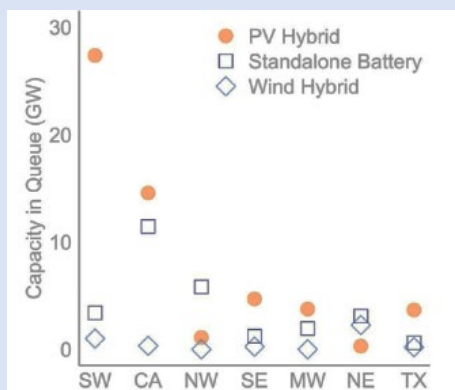
Status of Hybrid Resource Initiatives in U.S. Organized Wholesale Markets

April 10, 2020

Hybrid Resources Initiatives

Status: Initiatives currently underway in 5 RTOs/ISOs; discussions underway in 2 RTOs/ISOs

For the past year, developers and others around the country have had growing interest in hybrid resources involving battery storage coupled with power generation, particularly non-dispatchable solar and wind power. The significant increase in the number of hybrid resources appearing in interconnection queues is evidence of this trend. According to a [study by researchers at Lawrence Berkeley National Laboratory and Electric Power Research Institute](#), 4.6 GW of hybrid resource capacity is online today, 14.7 GW of hybrid resources are in the immediate development pipeline, and 69 GW of hybrid resources are in select interconnection queues. Figure 1 illustrates a regional breakdown of U.S. hybrid and standalone battery projects at the end of 2018, based on ISO/RTO and additional utility queue data.



Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs) have taken notice of this, and have begun to devote more time and attention to this topic. To date, all seven RTOs and ISOs are discussing hybrid resources with stakeholders in an effort to pave the way for greater participation opportunities for these resources, with five markets actively undertaking new rules development. The scope and pace of these discussions vary greatly across different regions.

Additionally, the Federal Energy Regulatory Commission has announced a [technical conference on hybrid resources](#) for July 23, 2020, and opened a docket on the subject (AD20-9), raising the prospect of a rulemaking in the near future. ESA has previously suggested that a rulemaking on hybrid resources could follow the format of Order 841, which directed RTOs/ISOs to devise a new participation model for standalone energy storage resources.

Figure 1. Hybrid Resources in Generator Interconnection Queues
Source: Lawrence Berkeley National Laboratory

The following summary tables provide an overview of the present status of hybrid resource discussion in each RTO and ISO, the scope of their discussions or initiatives, as well as their capacity accreditation approach for valuing hybrid resources in capacity markets.



Current Status by RTO/ISO

CALIFORNIA INDEPENDENT SYSTEM OPERATOR (CAISO)	
Committee	N/A (CAISO Hybrid Resources Initiative)
Status	Straw proposal underway since the fall of 2019 with revisions published in December 2019 following stakeholder comments.
Timing	<ul style="list-style-type: none"> • May 7, 2020: Second revised straw proposal to be released (previously this date was 4/7) • May 14, 2020: Meeting • May 28, 2020: Comments due on second revised straw proposal • June 16, 2020: Draft final proposal (phase 1) • June 23, 2020: Meeting • June 2020: Board of Governors and EIM Governing Body meetings (phase 1) • November 2020: Board of Governors and EIM Governing Body meetings (phase 2)
Current Scope	Straw proposal covers business drivers and use cases, forecasting proposal, modeling and charging capability for hybrid and co-located resource configurations, market participation proposal for hybrid resources (HRs), data and telemetry, and resource adequacy (RA).
Resources	<ul style="list-style-type: none"> • Original Straw Proposal (September 2019) • Revised Straw Proposal (December 2019)

NEW YORK INDEPENDENT SYSTEM OPERATOR (NYISO)	
Committee	Business Issues Committee (BIC) - ICAP Working Group
Status	NYISO began a hybrid resources (HR) discussion in ICAPWG at beginning of this year (1/13 ICAPWG meeting), where they discussed plans to develop a Hybrid Storage Model for allowing large FTM ESR paired with generation, or paired DERs, to participate in its markets. The Hybrid Storage Model project will evaluate co-located ESR to receive a single schedule and dispatch signal. The project will also evaluate a “virtual hybrid” option for a bilateral transaction between a standalone renewable resource and a standalone ESR (and in this configuration, the resources would be behind separate interconnections; this would be a way to potentially claim the ITC).
Timing	<p>Launched in January 2020; planned completion of Hybrid Storage Model proposal by fall 2020 (with potential vote by the BIC at end of 2020)</p> <ul style="list-style-type: none"> • Q1 2020: Initiate discussions on market concepts for HRs • Q2 2020: Continue discussions on market participation concepts for HRs; Present Market Design Concept Proposal to stakeholders • Q3 2020: Present consumer impact analysis and completed market design to stakeholders • Q4 2020: Market participation model will be developed for a potential vote at BIC by the end of 2020
Current Scope	<p>Development of a Market Participation Model. Will entail exploration of:</p> <ul style="list-style-type: none"> • Participation in NYISO’s Energy and Ancillary Services markets • Participation in NYISO’s Installed Capacity markets • Settlement process • Modeling for interconnection, planning, and operations • Metering requirements
Resources	<ul style="list-style-type: none"> • 1/13/20 Meeting Materials (Hybrid Resource Model Presentation)



ELECTRIC RELIABILITY COUNCIL OF TEXAS (ERCOT)	
Committee	Technical Advisory Committee (TAC) - Battery Energy Storage Task Force (BESTF)
Status	<p>BESTF launched in the fall of 2019 to develop policy recommendations related to these resources' integration into the grid. There are two types of Hybrid Resources under discussion in ERCOT: (1) AC-coupled resources, where each resource has its own inverter; and (2) DC-coupled resources, where resources share an inverter. ERCOT feels that existing rules and software are sufficient for AC-coupled resources (so implementation can be immediate). Therefore, the focus of the HR discussions in ERCOT is on DC-coupled resources. The group will consider operational and market design policies for DC-coupled resources that can be implemented in the short term and rules that can be implemented on a longer timeline using a two-step approach:</p> <ul style="list-style-type: none"> (1) rules that can be implemented in the short-term to integrate battery ESR under the "combination model" structure where resources are treated in ERCOT as a Generation and Controllable Load Resource Combination; and (2) rules that can be implemented on a longer timeline to integrate battery ESR under a "single model" structure where ERCOT will consider a DC-coupled resource as a single device for charging and discharging.
Timing	<p>BESTF launched in Fall 2019;</p> <ul style="list-style-type: none"> • December 2019: the business case for hybrid resources was discussed. • March 2020: reached consensus on KTC's 11, 12, 13, and 14 (these KTC documents provide guidance on how the Nodal Protocol Revision Requests (NPRRs) and related documents are to be drafted) <ul style="list-style-type: none"> ○ KTC 11: DC-coupled resources (various changes proposed) ○ KTC 12: AC-coupled resources (no changes proposed because existing rules still work) ○ KTC 13: Self-limiting Issues related to Interconnection Requests for ESRs ○ KTC 15: Proxy Process for ESR Bids/Offers and A.S. Offers (for both Combo Model and Single Model) • 4/3/2020: KTCs 11-15 were approved by TAC • May 2020: plan to release nodal protocol revision requests (NPRR); once submitted to the Protocol Review Subcommittee, each NPRR will be reviewed at several subcommittees, including the BESTF, and eventually sent to TAC; after TAC approval, it would go to the Board of Directors for their approval. • May–December 2020 (near-term): implementation of a "Combo Model ESR" • Mid 2024 (longer-term): switch to a "Single Resource Model"
Current Scope	As stated earlier, the focus in ERCOT is on developing operational and market design rules for DC-coupled resources. The specific focus is on DC-coupled resources with solar and wind (all other technologies are out of scope). In meetings, ERCOT has specified plans to review a wide range of topics such as forecasting, participation model, mitigation, telemetry, planning studies, generation interconnection studies, energy offer/bid curve and RTM energy bidding and settlements.
Resources	<ul style="list-style-type: none"> • 4/1/20 BESTF Meeting Materials (includes updates on KTC 11, 12, 13, and 15)



MIDCONTINENT INDEPENDENT SYSTEM OPERATOR (MISO)	
Committee	Market Subcommittee (primary committee); other committees are Planning Advisory Committee and Resource Adequacy Subcommittee
Status	<ul style="list-style-type: none"> • MISO is working on 22 hybrid resource issues across the broader topics of RA, Planning/Interconnection, and Market Operations. MISO planned to develop an initial participation model by March, but this has now been pushed to Q2 of 2020. • On 3/11/20, MISO shared the initial results from the Integrated Roadmap Stakeholder Prioritization process. MISO ranked Hybrid Resources as a low priority (because they said it would affect a small subset of market participants), but stakeholders had ranked high. MISO recognized this discrepancy. • The plan was for MISO next to deliver the final prioritization workshop and provide an update on the Integrated Roadmap 5 Year Workplan on 4/8/20, but this is now postponed to 6/10/20. ESA anticipates that this issue will be dealt with in the Markets Subcommittee. • Hybrid capacity accreditation going forward is expected to be housed under the Resource Adequacy Subcommittee (RASC). The hybrid issue is under the Resource Availability and Need (RAN) - Resource Accreditation (RASC010), inclusive of: <ul style="list-style-type: none"> ○ IMM 2018-5 (hybrid accreditation) ○ Hybrid Issues from the Energy Storage Task Force ○ IR095 - Forward Capacity Accreditation for Renewable Resources & IR096 - Forward Capacity Accreditation for Use-Limited Resources • PAC has reviewed 6 Hybrid issues that relate to <ul style="list-style-type: none"> ○ Generator Interconnection <ul style="list-style-type: none"> ▪ How a hybrid resource will be studied in the generator interconnection process ▪ Control systems to ensure output does not exceed interconnection service level; what processes can be used to ensure that net output does not exceed interconnection service ○ Surplus Interconnection <ul style="list-style-type: none"> ▪ Identify a viable path to add energy storage to existing generators through the Net Zero process for the purposes to firming capacity ▪ Endeavor to clarify the material modification threshold as it applies to storage being added to existing renewables through the Net Zero process and specify appropriate study assumptions ○ Displacement Agreement for Hybrid Resources <ul style="list-style-type: none"> ▪ Displacement agreements between an energy and capacity resource will be part of a Net Zero condition complicating compliance with must-offer obligations. ○ Temporary violation of Interconnection Rights to provide Ancillary Services <ul style="list-style-type: none"> ▪ Allow hybrid projects to briefly increase their output above their injection limits and transmission system thermal limits (but not stability limits) to provide primary frequency response and other short-duration upward ancillary services
Timing	<ul style="list-style-type: none"> • The Planning Advisory Committee has been discussing aspects of hybrid resources for a number of years, such as Net Zero Interconnection. • 3/11/20: the Market Subcommittee began discussing this. • 6/10/20: MISO to deliver the final prioritization workshop and provide an update on the Integrated Roadmap 5 Year Workplan
Current Scope	Hybrid Resource Participation Model Development. Specific topics include capacity accreditation, planning/interconnection, and market operations.
Resources	<ul style="list-style-type: none"> • 2/12/2010 PAC Meeting Materials (includes more detailed status on hybrid issues related to generator interconnection, surplus interconnection, displacement agreement for hybrid resources, and temporary violation of interconnection rights to provide A.S.) • Committee Assignment document (shows which committees have primary responsibility for various hybrid resource topics)



PJM INTERCONNECTION

Committee	Markets and Reliability Committee
Status	PJM launched their work on HRs this March at their 3/26/20 Markets and Reliability Committee meeting. PJM presented a first read of a problem statement/issue charge to create a new Task Force to develop potential new rules for solar-battery hybrid resources, which make up 95% of the of co-located generation and storage hybrid resources in the interconnection queue. The task force will specifically explore development of an ELCC methodology for limited duration resources such as ESR. Phase I of their work will cover wind and solar; Phase II will cover hybrid resources. The committee will be asked to endorse the Issue Charge at its next meeting on 4/30/20 and formally launch the Task Force.
Timing	<p>Launched March 2020</p> <ul style="list-style-type: none"> • 3/26/20: Markets and Reliability Committee meeting (discussed problem statement/Issue Charge to create Capacity Capability Senior Task Force) • 4/7/20: PJM Capacity Capability Senior Task Force meeting • 4/30/20: Markets and Reliability Committee meeting (will be asked to endorse the Issue Charge) • Other dates TBD (since they've only recently begun to explore the possibility of new rules)
Current Scope	Solar-battery Hybrid Resources. Specific topics include Energy and Ancillary Services; Metering and Telemetry; Calculating capability of solar-battery hybrids in capacity market, and Market Modeling.
Resources	<ul style="list-style-type: none"> • PJM's FAQ on hybrid resources during the Order 841 compliance filing development process • Issue Charge and Problem Statement documents

SOUTHWEST POWER POOL (SPP)

Committee	Markets and Operations Policy Committee (Supply Adequacy Working Group, Electric Storage Resource Steering Committee, Market Working Group, and Operating Reliability Working Group)
Status	<ul style="list-style-type: none"> • Electric Storage Resources Steering Committee: They began discussing a January 2020 paper, "Electric Storage Resource White Paper," and how to divide up roles and responsibilities to cover issues in this paper. They have a live document on SPP's ESRSC website to keep track of which groups have responsibility for various tasks. Task "E2" (an energy and Related Service issue) takes on the responsibility of exploring modeling of hybrid projects as one resource for economic optimization, instead of modeling ESR and renewable energy separately. <ul style="list-style-type: none"> ○ Current Responsible Groups: Market Working Group, Operating Reliability Working Group, and SPP Staff (but roles could be in flux) • Supply Adequacy Working Group: Since the beginning of this year, they've been discussing a January 2020 paper on "Energy Storage Accreditation Methodology," which includes a line item for "Hybrid Resource Consideration" and requests feedback from stakeholders.
Timing	<p>ESRSC first met in March 2020</p> <ul style="list-style-type: none"> • 3/3/20: ESRSC's first meeting, which was an overview of what ESRSC was, a review of ESRSC scope, and a review of the Electric Storage Resource White Paper • 3/13/20: ESRSC's second meeting; began the prioritization process of storage issues from the Electric Storage Resource White Paper. • 4/2/20: ESRSC reviewed the highest priority energy storage topics • 4/14/20: ESRSC may present a prioritization of issues (including hybrids) at the MOPC meeting, however, this could get pushed to the summer <p><u>Note</u>: a policy decision on E2 is not anticipated prior to the October MOPC meeting</p>
Current Scope	Hybrid Resource Modelling (discussing two modeling options for renewable generation co-located with storage: standalone modeling and hybrid modeling) and ELCC for Hybrid Resources
Resources	<ul style="list-style-type: none"> • ESRSC Materials and Notes



INDEPENDENT SYSTEM OPERATOR NEW ENGLAND (ISO-NE)	
Committee	NEPOOL Reliability Committee and NEPOOL Markets Committee
Status	<p>ISO-NE staff has discussed this topic offline but hasn't formally taken it up.</p> <ul style="list-style-type: none"> Reliability Committee: will cover hybrid resources in so far as it impacts operating procedures Markets Committee: will handle corresponding conforming changes to the manual <p>On 3/30/20, the NEPOOL Reliability Committee sent out notification saying that co-located facility participation will evolve and be vetted through the NEPOOL stakeholder process. The committee compiled the range of options by which co-located intermittent generation and electric storage can participate in the forward capacity, energy, reserves, and regulation markets. They shared a link to a training webinar that will be available by 4/8/20 that will inform market participants of options for co-located resource participation. They also have an ISO Training mailing list that you can sign up with to receive notifications about this first training webinar and other upcoming trainings (just send an email to this email address to request to be added). Lastly, they shared a link to a form where you can indicate your interest for a new co-located resource or modify an existing co-located resource.</p>
Timing	<ul style="list-style-type: none"> 4/8/20: Webinar Training 4/22/20 – May 2020: Reliability Committee will likely discuss DC-metering for co-located facilities.
Current Scope	Market Participation (participation of co-located intermittent generation and ESR in forward capacity, energy, reserves, and regulation markets), and DC-metering for co-located resources.
Resources	<ul style="list-style-type: none"> April 8th Webinar Link Subscribe to ISO Training Mailing List: isolist-isotraining-subscribe@mail.iso-ne.com Show of interest form

Comparison of Hybrid Resource Initiative Scopes

ISO/RTO	Forecasting	Market Mitigation /Physical Withholding	Market Participation & Software Scheduling (MOOs)	Capacity Accreditation and MOO rules	Offer Parameters (bidding flexibility; RT offer updates)	Interconnection (queue position; interconnection constraint; study scenarios)	Resource Planning	Metering & Telemetry
CAISO	X		X	X	X	X		X
NYISO			X				X	X
ERCOT	X	X	X	X	X	X	X	X
MISO	X		X	X	X	X	X	X
PJM			X	X			X	X
SPP				X			X	
ISO-NE			X					X



Issue in Brief: Capacity Accreditation

CAPACITY ACCREDITATION APPROACHES	
CAISO	<p><u>Co-located Resources</u>: Currently, wind and solar resources are evaluated via ELCC; ESR are evaluated based on its Pmax and 4-hour duration sustained output. These Qualifying Capacity (QC) methodologies are applied to each co-located resource and each resource ID would receive a standalone QC and Net Qualifying Capacity (NQC). CAISO did not see any issues with the current counting rules, so they did not propose modifications in the Straw Proposal.</p> <p><u>Hybrid Resources</u>: Currently, there are no established rules for this. CAISO proposed in Original Straw Proposal (OSP) to use existing QC methodologies for solar and ESR components and adds them together. Since the OSP was issued, the California Public Utilities Commission (CPUC) issued a Policy Decision that would set HR QC at the greater value of the components rather than the sum, on an interim basis. CAISO proposed adopting this “greater of” methodology in their December 2019 Revised Straw Proposal, which several stakeholders said they were not in favor of in their comments in January 2019. Expect updates when the second revised straw proposal is released on 5/7/2020; this will be followed by a comment</p>
MISO	TBD. Discussions are still at an early stage. This issue is part of the current MISO 2021 Integrated Roadmap Work Plan prioritization process. Discussions will take place after the 6/10/20 Integrated Roadmap Workplan update. Moving forward, hybrid resource accreditation is expected to be housed in the Resource Adequacy Subcommittee. Based on CES’ assessment, MISO seems to presently be leaning towards more of a QC process
ISO-NE	TBD. In February 2019, ISO-NE had capacity market trainings that mentioned co-located facilities and said they will be treated as separate resources but did not provide details. Webinar training on 4/8/20 will likely discuss this again and hopefully address this topic more directly.
PJM	PJM has said that it plans to calculate the capability of solar-battery HRs in their capacity market. On 4/7, a new ELCC task force—PJM Capacity Capability Senior Task Force—had its first meeting. This Task Force will look into developing an ELCC methodology for limited duration resources such
NYISO	TBD.
ERCOT	N/A
SPP	The “Energy Storage Accreditation Methodology” paper from January 2020 includes a line item for hybrid resources. Astrape Consulting has been involved in modeling efforts for this, including some configurations of storage and solar hybrid projects, but only considered DC-coupled systems. Feedback indicated a need for additional modeling for a broader variety of Solar + Storage ratios and varying penetration levels for storage and solar. Thus, AC-coupled system modeling was requested. SPP has focused some of their efforts on stand-alone storage for ELCC at this time, but these studies will be a continuous process going forward.



Further Information

For more information on this summary, contact ESA at info@energystorage.org

ADDITIONAL RESOURCES

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ESA and Grid Strategies LLC	<p>Enabling Versatility: Allowing Hybrid Resources to Deliver Their Full Value to Customers</p> <ul style="list-style-type: none">This paper assesses barriers to and proposes solutions for enabling storage-plus-generation hybrid resource deployment on the bulk power system, particularly in organized wholesale markets administered by RTOs and ISOs. The authors developed the materials and recommendations discussed in the paper through interviews with developers of hybrid resources, grid operators, and transmission owners, as well as our own analysis.
Energy Systems Integration Group	<p>Hybrid Power Plants - Flexible Resources to Simplify Markets and Support Grid Operations (working draft)</p> <ul style="list-style-type: none">In this paper, the authors suggest that future deployment of energy resources on the electric power system will increasingly be in the form of Hybrid Resources and offer their approach for how hybrid resources can participate in current wholesale markets (with existing market rules and energy management systems) as resources that are treated comparably to conventional resources.
LBNL and EPRI	<p>Hybrid Power Plants Are Growing Rapidly: Are They a Good Idea?</p> <ul style="list-style-type: none">New research from LBNL and EPRI look at the operational benefits and drawbacks, relative costs and benefits, and industry trends toward hybrid power plants. Resources include an article and a webinar.