



California ISO

Hybrid Resources Draft Final Proposal

August 10, 2020

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CAISO Public

Agenda

Time	Agenda Topic	Presenter
10:00 - 10:05	Welcome and Introduction	James Bishara
10:05 - 10:30	Timeline and background	Gabe Murtaugh
10:30 - 11:10	Market interaction	Gabe Murtaugh
11:10 - 12:00	Co-located storage deviation	Gabe Murtaugh
12:00 - 1:00	Lunch	
1:00 - 1:30	Metering	Gabe Murtaugh
1:30 - 2:30	Bidding for Hybrids	Gabe Murtaugh
2:30 - 2:55	Resource Adequacy	Gabe Murtaugh
2:55 - 3:00	Next Steps	James Bishara

ISO Policy Initiative Stakeholder Process



TIMELINE AND BACKGROUND

Timeline for hybrid resources initiative

Date	Item
7/22/20	Board of Governors meeting for co-located
8/3/20	Publish DFP
8/10/20	Public stakeholder call for draft final proposal
10/6/20	Publish final proposal (tentative)
10/14/20	Public stakeholder call for final proposal (tentative)
11/4/20	EIM GB Meeting
11/18/20	Board of Governors Meeting
12/1/2020	Implementation of co-located constraint (Energy only)
2/1/21	Co-Located Storage Deviation – Tariff Approval
Fall 2021	Remaining implementation for hybrid policy

Significant updates from the second revised straw proposal

- ISO is allowing functionality for co-located storage resource to deviate from dispatch in limited circumstances
- Posted a white paper on high sustainable limit
- Included examples for hybrid resource bidding
 - Clarified use of outage cards and dynamic limits
- Clarified treatment of resources seeking ITC
- Explicitly required that hybrid resources supply SOC data to the ISO
- Explicitly required that hybrid and co-located resources supply HSL

This proposal continues using two models for facilities with multiple gen types: hybrid and co-located

- **Co-located Resources – Multiple Resource IDs behind a single point of interconnection**
 - Each resource is modeled and submits bids to the ISO independently
 - ISO will model state of charge, VER forecasts, heat rates independently as appropriate
- **Hybrid – Single Resource IDs, with multiple mixed-fuel components behind a single point of interconnection**
 - ISO receives one bid curve from the hybrid resource which should include any internal optimization
 - Hybrid resource should always be able to respond to any dispatch instruction from the ISO

MARKET INTERACTION – HYBRID RESOURCES

Co-located policy was approved by the Board of Governors in July and will be implemented fall 2020

Review of approved co-located policy:

- Co-located resources will bid consistently with current ISO rules for specific resource types
 - No change from existing treatment today
- Co-located resources will be subject to the aggregate capability constraint
 - Constraint will prevent dispatch beyond interconnection limits
- Co-located resources subject to the ACC will not be allowed to provide ancillary services until fall 2021

Co-located storage will have the ability to absorb additional energy from renewable output in early 2021

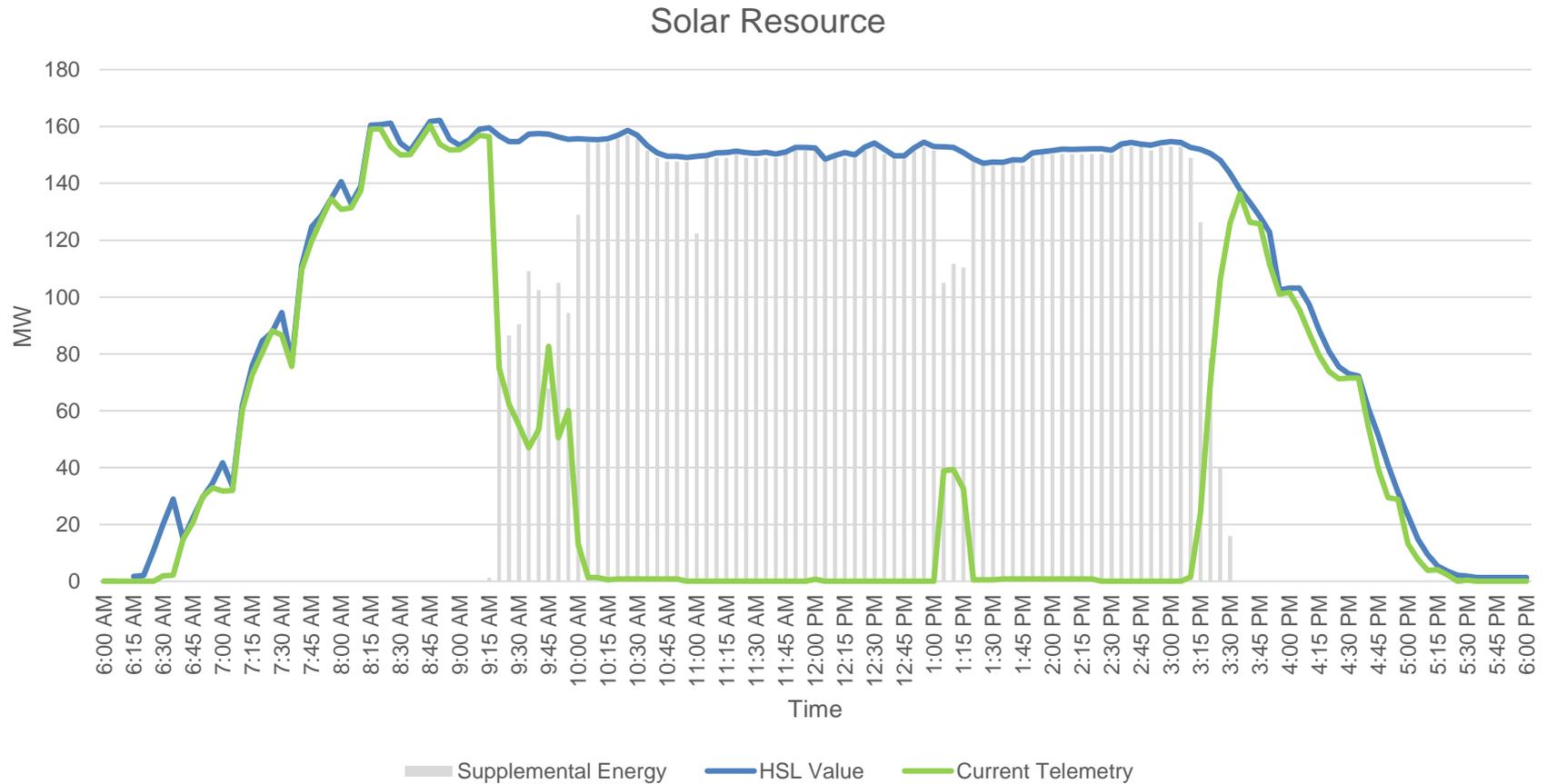
The ISO needs to understand underlying variable components for all generation on the system

- Today the ISO collects a significant amount of data for forecasting output for variable energy resources
 - The ISO also provides forecasts (or allows variable energy resources to provide their own) for all variable energy resources on the system
- Hybrid resources will be required to provide information on underlying variable components for forecasting and grid reliability
 - Topographical Map
 - Site information sheet
 - Real-time meteorological station data
 - Real-time forecast and telemetry data
 - High-sustainable limit
- High-sustainable limit is a new measurement that is a real-time telemetered estimate of what a variable component is capable of producing
- Data will also be used for reporting WREGIS information

The ISO will collect high sustainable limit information from hybrid and co-located variable components

- The high sustainable limit allows the ISO to better forecast expected output from generation
 - Today ISO only sees actual output, which could be influenced by dispatch instructions
- As VERs are curtailed more frequently, the ISO has less visibility into the amount of potential energy generation
 - This could increase if more hybrid and co-located resources are constrained by interconnection limits
 - May increase as the number of VERs on the system increases
- HSL will allow for improved forecasting during intervals where there is no other insight into maximum capability
- HSL values may inform ISO about system/local reliability

The ISO will collect high sustainable limit information from co-located VERs and hybrid variable components



Hybrid resources will be subject to many of the same market principles as other resources

- Hybrid resources will bid a single bid curve into the DA and RT markets
 - Hybrid resources will be dispatched like other resources on the system
 - Bids can change from hour to hour, and may range from P_{min} to P_{max}
- Hybrid resources are required to respond to ISO dispatch instructions
- Hybrid resources are subject to uninstructed imbalance energy for any energy that is not delivered
- Hybrid resources can manage range of dispatch with outage cards and dynamic limits
- ISO will collect state of charge for hybrid resources but will not be dispatching resources to optimize or manage this value
 - Hybrid resource are responsible for self-managing state of charge

New tools will be required for hybrid resources to operate and perform in the market

- Hybrid resources will face similar challenges as existing resources
 - Variable generation capability for certain hybrid components
 - State of charge for storage components
- Dynamic limits will be established for hybrid resources
 - Hybrid resources will have the ability to manage variable output through a 'dynamic limit tool'
 - This tool will be based on similar technology that the ISO already uses for variable energy resources
 - Limits will be submitted to the ISO every 5-minutes, for a 3 hour period
- Hourly unavailability for hybrid resources should be submitted to the ISO via the outage management system

The dynamic limit tool limits the generation range that the ISO can dispatch hybrid resources

- **Example hybrid resource:**
 - 100 MW Solar resource
 - +/-100 MW storage resource (4 hour storage → 400 MWh)
 - +200 MW of interconnection capacity for injections into the ISO grid
 - -100 MW of ability to withdraw from grid (charge hybrid component)
- **Solar generation is expected to increase from 35 MW to 89 MW during the hour**
 - An outage card for the entire hour should be submitted to indicate that the resources will not produce above 189 MW (derate from 189-200 MW)
 - For the first interval of the hour, the SC will submit a series of estimated upper and lower limits of possible generation from the resource covering a forward 3-hour time span
 - The first interval indicates the hybrid is capable of producing 135 MW, at most
 - Estimated limits will be updated every 5 minutes

The dynamic limit tool limits the generation range that the ISO can dispatch hybrid resources

- Resources may update outage cards each hour, or more frequently as hybrid operations changes
 - Outage cards must include generation that the resource is incapable of delivering during the hour
 - Solar+Storage hybrid resources will enter outage cards at night to indicate no generation from the solar component
- The dynamic limits will include upper and lower limits
 - A hybrid resource may plan to partially charge a storage component from the onsite generation, and may be willing to charge the resource additionally from the grid, given the correct economic incentive
 - These limits only reduce the range of what the resource could be dispatched to
 - This will not update dollar values associated with bid curves, inclusive of multi-step curves (i.e. the curves will not be ‘shrunk’ to fit the limits)

CO-LOCATED STORAGE DEVIATION FROM DISPATCH

Several stakeholders suggested new functionality to allow storage resources to deviate from dispatch

- Allow storage resources to offset the deviations from co-located variable energy resources
- Aligns with state goals encouraging renewable energy
 - Helps minimize curtailing solar production
- ISO proposal includes this functionality, with no impacts to existing software
- Change would go to the November board and be implemented immediately after FERC approval
 - Independent from full hybrid policy, which will be active in the Fall 2021
 - Likely to have this capability active by Feb 1, 2021

Tool to allow co-located storage resources to deviate from dispatch to 'absorb' excess solar

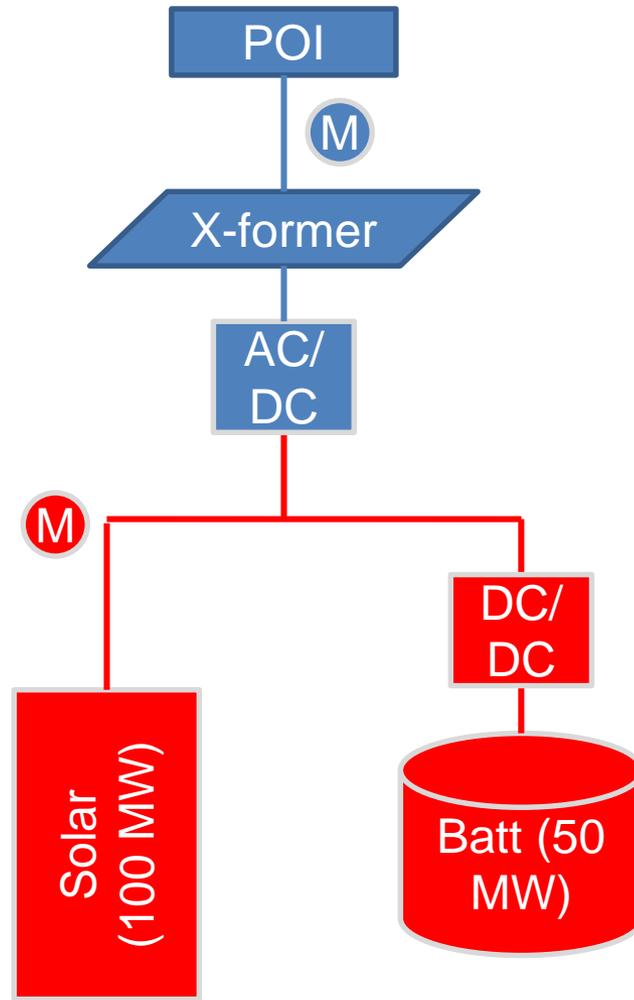
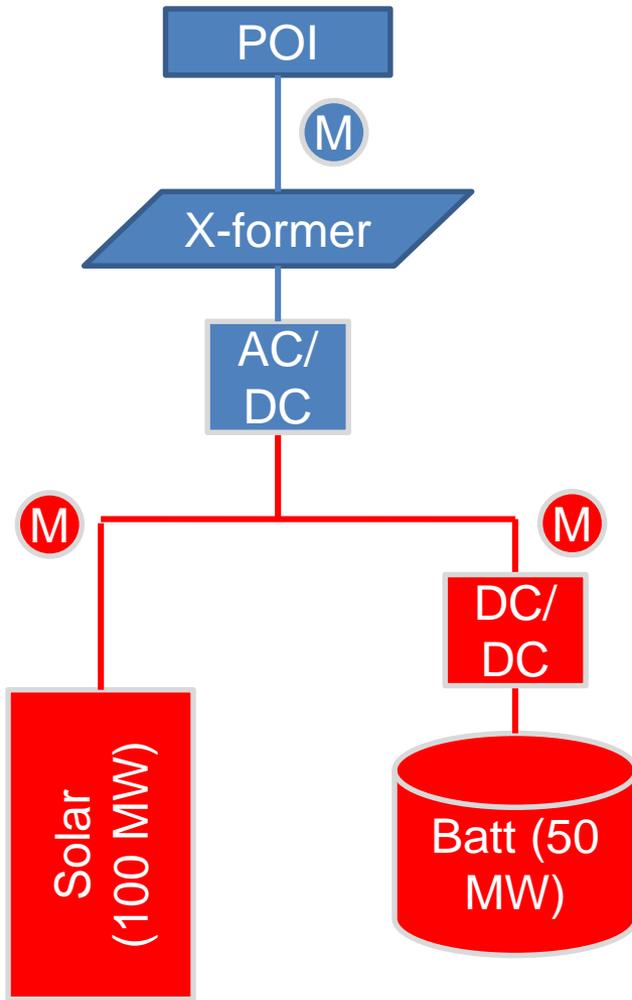
- Will only be allowed when co-located resources could produce above their POI
 - Only for intervals when the VER resource is producing above dispatch
 - Will prevent potential solar energy from being 'wasted'
 - Likely to be infrequently used
- The ISO will not share data for co-located resources
 - ISO may review SOC and VER data to ensure that no 'gaming' occurs
 - Capability must be demonstrated to the ISO, prior to allowing this functionality
- All deviation from dispatch will be treated as UIE
 - Will be subject to flexible ramping changes
 - No changes to settlement
- When resources are exercising this option they may not be providing ancillary services at the same time

METERING

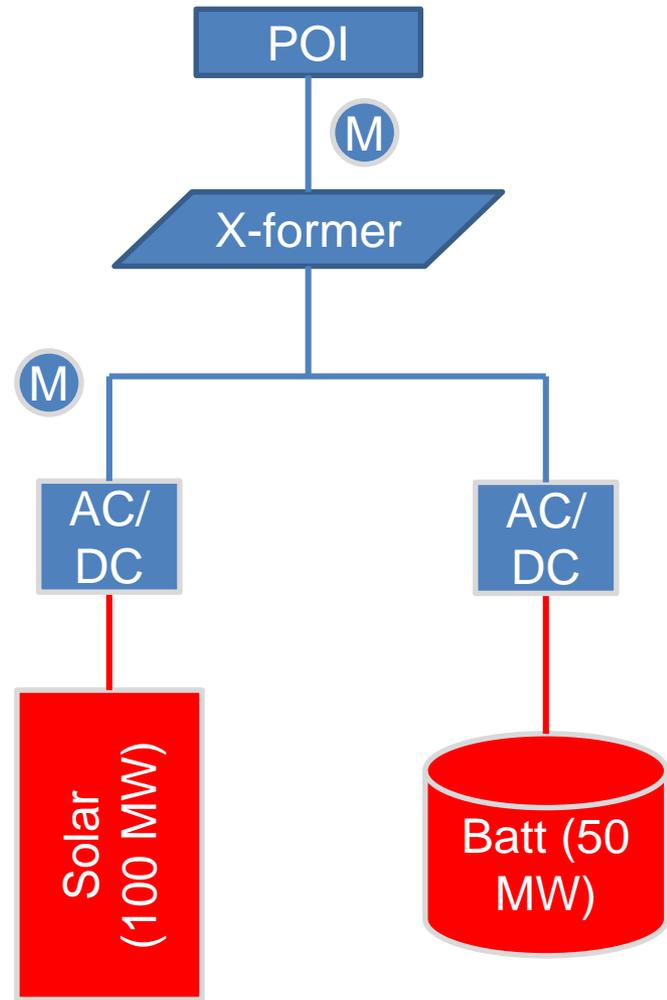
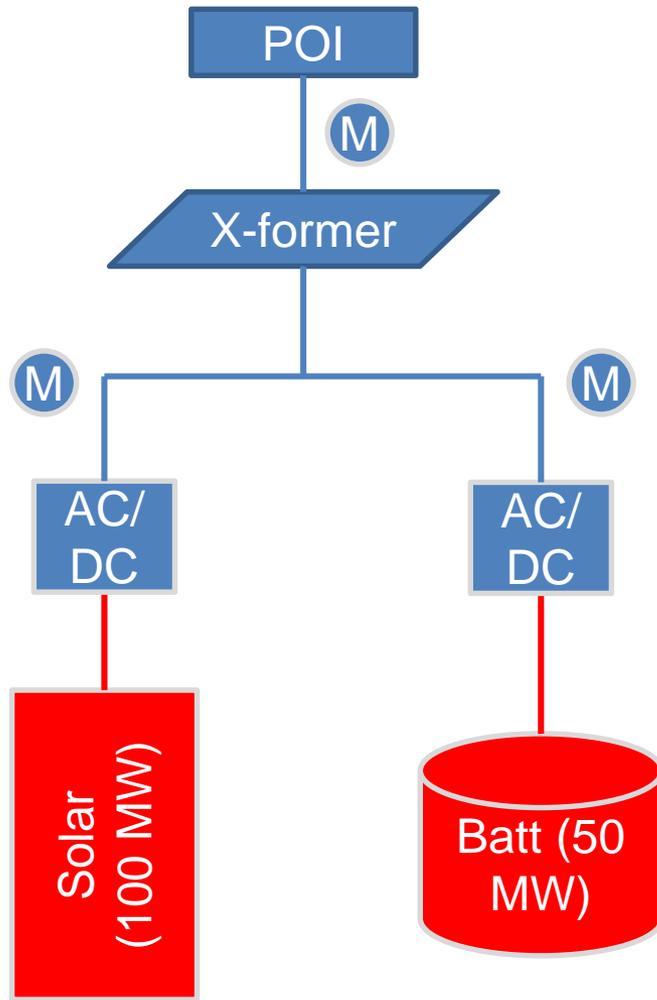
Each resource interconnecting to the ISO will go through the interconnection process

- ISO ensures that metering is sufficient and that accurate information will be passed to the ISO
 - Hybrid resources will be required to provide meter quality data for energy injected/withdrawn to the grid at the interconnection
 - Each co-located resource will be required to provide meter quality data for energy generated from each resource and aggregate energy injected onto the grid
 - All variable energy resources/components will be required to meter data for energy generated for forecasting and renewable accounting purposes
- Each interconnected resource on the grid is unique. ISO staff will continue to work with interconnection customers to ensure that the metering solution is sufficient to meet metering requirements

Potential DC metering for co-located and hybrids



Potential DC metering for co-located and hybrids



BIDDING FOR HYBRID RESOURCES

Example bidding strategy for a hypothetical hybrid resource in the day-ahead market

	...	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	...	
	...	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	...	
Expected Solar:	...	0	0	0	5	20	75	95	100	100	100	98	75	30	0	0	0	0	...	
Expected DA Price:	...	\$30	\$45	\$35	\$25	\$20	\$22	\$15	\$15	\$24	\$27	\$32	\$37	\$52	\$55	\$75	\$58	\$30	...	
Exp SOH En (MWh)	...	100	100	0	0	0	100	200	300	400	400	400	400	400	300	200	100	0	...	
Bid (MW1)	...	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	...
Bid (Price1)	...	\$18	\$18	\$18	(\$15)	(\$15)	(\$15)	(\$15)	(\$15)	(\$15)	(\$15)	(\$15)	(\$15)	(\$15)	\$18	\$18	\$18	\$18	...	
Bid (MW2)	...	0	0	0	-95	-80	-25	-5	0	0	0	-2	-25	-70	-100	0	0	0	...	
Bid (Price2)	...	\$40	\$40	\$40	\$23	\$23	\$23	\$23	\$23	\$23	\$23	\$23	\$23	\$23	\$40	\$40	\$40	\$40	...	
Bid (MW3)	...	-	-	-	5	20	75	95	100	100	100	98	75	30	-	-	-	-	...	
Bid (Price3)	...	-	-	-	\$40	\$40	\$40	\$40	\$40	\$40	\$40	\$40	\$40	\$40	-	-	-	-	...	
Outage Above (MW)		100	100	100	105	120	175	195	-	-	-	198	175	130	100	100	100	100	...	
Exp DA award	...	0	100	0	5	-80	-25	-5	0	100	100	98	75	130	100	100	100	0	...	

- Bid curves may incorporate charge/discharge/renewable components
- Outage cards submitted to the ISO for hours not at full output
- Schedules based on spreads in the market

Example bidding strategy for a hybrid resource in the real-time market

	...	11:00	11:05	11:10	11:15	11:20	11:25	11:30	11:35	11:40	11:45	11:50	11:55	...
Expected Solar:	...	35	45	54	60	65	70	75	79	83	86	88	89	
RT Price:	...	\$20	\$22	(\$10)	(\$10)	\$18	\$15	\$16	\$16	\$16	\$200	\$20	\$20	
Exp SOI En (MWh)	...	100	105.4	111.7	118.7	126.2	134.1	142.4	151.2	160.3	169.7	161.3	171.2	
Bid (MW1)	...	-100												
Bid (Price1)	...	(\$15)												
Bid (MW2)	...	-30												
Bid (Price2)	...	\$23												
Bid (MW3)	...	35												
Bid (Price3)	...	\$40												
Outage Above (MW)	...	189												
Dynamic Limit	...	135	145	154	160	165	170	175	179	183	186	188	-	
Exp RT award	...	-30	-30	-30	-30	-30	-30	-30	-30	-30	186	-30	-30	
Battery Output (MW)	...	65	75	84	90	95	100	100	100	100	-100	100	100	
Solar Curtailment	...	-	-	-	-	-	-	5	9	13	-	18	19	

Investment tax credits should be captured in bids to the extent possible

- There were many comments referencing the need for the ISO to consider ITC implications for charging
- ISO understands that the proportion of energy used to charge resources from the grid will reduce ITC
 - I.e. A maximum amount of ITC credit is calculated and used as a baseline
 - A resource that charges 1% of energy from the grid is then only eligible for $.99 * \text{baseline ITC}$

Eg. +/-100 MW 4-hour storage, \$30M cost/year, ITC potential \$10M/year

- Resource is expected to cycle one time per day $(100 \text{ MW} * 4 * 365) = 146,000 \text{ MWh}$
- One hour of charging from the grid $\frac{1 \text{ MWh}}{146,000 \text{ MWh}} = .0007\%$
- The marginal cost for charging during the hour: $\$10M * .0007\% = \$68/\text{MWh}$

Example bidding strategy for a hybrid resource with investment tax credit

	...	6:00	6:05	6:10	6:15	6:20	6:25	6:30	6:35	6:40	6:45	6:50	6:55	...
Expected Solar:	...	0	0	0	0	0	0	0	0	0	0	0	0	
RT Price:	...	\$28	\$30	\$27	\$29	\$32	\$28	(\$150)	\$24	\$30	\$10	\$29	\$25	
Exp SOI En (MWh)	...	100	100	100	100	100	100	100	108.3	108.3	108.3	108.3	108.3	
Bid (MW1)	...	-100												
Bid (Price1)	...	(\$50)												
Bid (MW2)	...	0												
Bid (Price2)	...	\$40												
Exp RT award	...	0	0	0	0	0	0	-100	0	0	0	0	0	
Battery Output (MW)	...	0	0	0	0	0	0	100	0	0	0	0	0	

- Bidding at very low prices low or very low prices may prevent storage components from being charged from the grid
- When storage resources are charged from the grid, prices may be sufficiently low for compensation to outweigh ITC losses

RESOURCE ADEQUACY & MUST OFFER OBLIGATIONS

Hybrid resources will have many of the same requirements as other existing RA resources today

- Hybrid resources are subject to the same RA rules applied to NGR resources today
 - Resources have a 24x7 must offer obligation
 - Hybrid resources are allowed to bid in outage cards when not available because of onsite storage and VER component unavailability
 - Hybrid resources are subject to RAAIM during AAHs
- Hybrid and co-located resources have net qualifying capacity values constrained by interconnection limits
- The RA enhancements initiative to update counting and participation rules for resource adequacy
 - UCAP paradigm will apply to hybrid and co-located resources once this new policy is implemented for RA year 2023
 - Capacity will be calculated seasonally based on outages during the 20% of hours with the tightest supply availability, instead of pre-set hours

NEXT STEPS

Next steps

- All related information for the hybrid resources initiative is available here: <http://www.caiso.com/StakeholderProcesses/Hybrid-resources>
- Please submit stakeholder written comments on today's discussion and the hybrid resources draft final proposal by **August 26, 2020**

Important – Please review new process for submitting comments

- Provide comments using the new stakeholder commenting tool
- First-time users must register using their email address in order to submit comments on initiatives
- The commenting tool is located on the Stakeholder Initiatives landing page (click on the “commenting tool” icon):
<https://stakeholdercenter.caiso.com/StakeholderInitiatives>