



Stakeholder Comments Template

Hybrid Resources

This template has been created for submission of stakeholder comments on the Hybrid Resources Issue Paper that was published on July 18, 2018. The paper, stakeholder meeting presentation, and other information related to this initiative may be found on the initiative webpage at:

<http://www.caiso.com/informed/Pages/StakeholderProcesses/HybridResources.aspx>

Upon completion of this template, please submit it to initiativecomments@caiso.com. Submissions are requested by close of business on **August 13, 2019**.

Submitted by	Organization	Date Submitted
ALI CHOWDHURY, PhD, MBA Vice President – Transmission & Interconnection Phone 916.990.8027	8minute Solar Energy	8/12/2019

Please provide your organization’s comments on the following issues and questions. For all topics please explain your rationale and include examples if applicable.

1. Interconnection

Please provide your organization’s feedback on the interconnection topic as described in section 3.2.

None

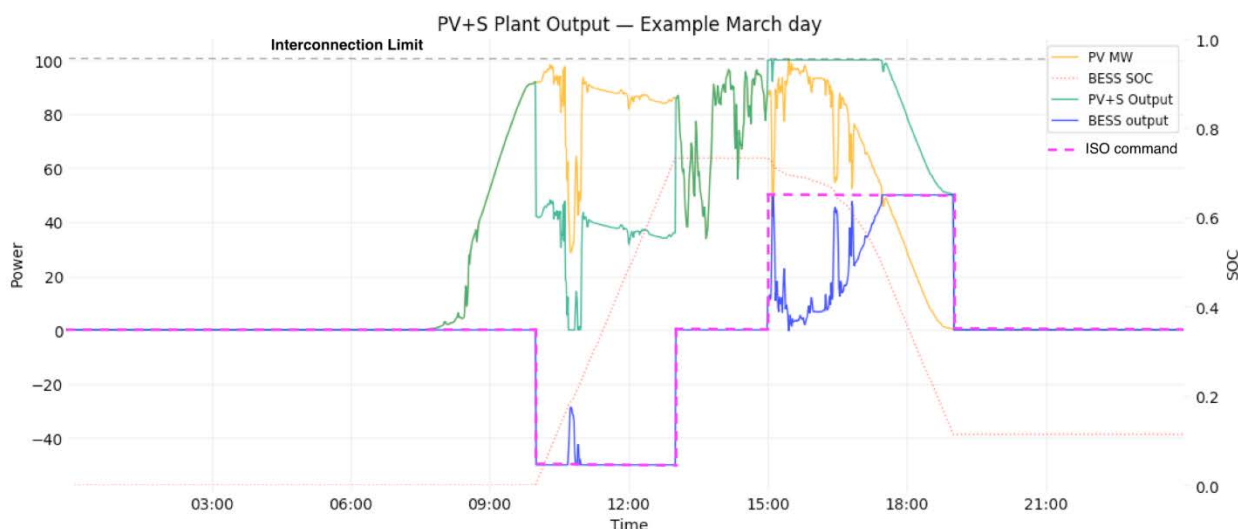
2. Forecasting and Operations

Please provide your organization’s feedback on the forecasting and operations topics as described in section 3.3.

Provisions accommodate the federal ITC grid charge limits

Annual grid charge limitations

Most hybrid PV+S systems deployed prior to 2024 are expected to participate in the federal investment tax credit (ITC) that will allow only a certain percentage of annual charging to come from the grid or no charging from the grid. In these cases the ESS must be able to read the onsite PV meter and reduce charging when the PV generation falls below the BESS charge command. This is illustrated at approximately 11 AM in the example below. 8minute does not see a method to manage grid charging through bidding. Observe the solar dip near 10:30 AM in the graph below. If the forecast was that the PV would produce steadily during that time then the system would have bid charge. However, when faced with a sudden PV drop the storage resource has no way to update its bid for that brief period.



SUGGESTED POLICY: The onsite ESS plant controller should report the daily and annual grid charging limits to comply with federal ITC limitations, and the current status via telemetry to the ISO at all times.

The ISO central dispatch should then attempt to manage the grid charging limitations. The onsite ESS plant controller should monitor the onsite PV generation and prevent grid charging as a backup to the CAISO (which 8minute expects that investors will require), and the project should not be penalized (other than charges for Uninstructed Imbalance Energy (UIE)) for failing to follow an ISO dispatch if it conflicts with onsite conditions. 8minute expects project investors to insist that the onsite ESS plant controller monitor the onsite PV generation and prevent grid charging as a backup to the ISO commands.

Alternatively, the ISO must be able to do the following or allow the onsite ESS plant controller to manage the ITC limitations.

State of charge management using advanced PV forecasts

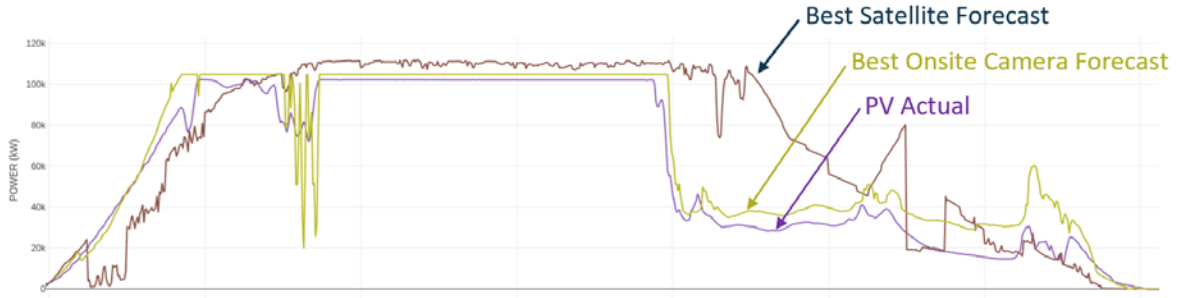
A typical mode of operation for resource adequacy (RA) and among other applications would be to require the ESS to be charged with 4 hours of energy ready for discharge by a certain

time in the afternoon. An example would be by 3 PM to support the evening ramp that was assigned in the day ahead market as part of the resources RA must offer obligation (MOO).

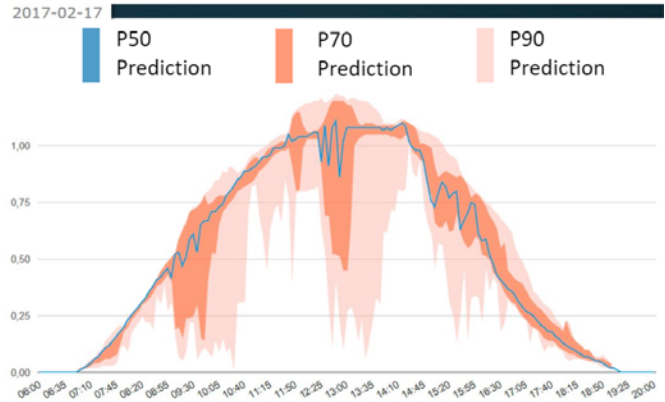
The process by which the BESS gets to 4 hours of charged energy when grid charging is not allowed should be managed using the highest quality PV forecast and algorithms that accommodate account for consider both when are the lowest grid prices of the day and solar availability make sure to charge the BESS when solar is available to be charged. The ISO normally manages co-optimization for prices, but if the central dispatch expects to charge an ESS with no grid charging allowed from 1 PM to 3 PM and the solar is only generating intermittently during that time, the ESS will need to deviate from CAISO dispatch instructions ignore some of the charge commands . The ESS in that example should have started charging earlier in the day to make sure it charges only from solar and still is ready to meet the day ahead dispatch at 3 PM.

It is 8minute's understanding that the ISO does not use onsite cameras to inform PV generation forecasts. only has access to satellite based forecasts of PV generation and that it is not tuned for onsite conditions. 8minute has performed tests of multiple satellite forecast providers and onsite optical and thermal cloud imaging cameras. 8minute found that forecast quality of the next hour improved by ~200% when using onsite thermal imaging and advanced machine learning to provide feedback to the forecast provider based on what actually occurs onsite . 8minute includes ensemble satellite based forecasts with onsite thermal cloud imaging and advanced machine learning feedback of the of PV generation to improve the forecast. This capability should be provided by an ensemble forecast of satellite plus onsite thermal cloud imaging or purchase an ensemble forecast from one known vendor. Without this more advanced forecast 8minute expects the ISO to struggle to manage grid charging and maintain reliability.

SUGGESTED POLICY: If the ISO cannot or will not provide this forecast and more advanced battery state of charge management using the forecast 8minute suggests the onsite storage plant controller be allowed to self-schedule charging or discharging in the 5 or 15 minute settlement interval. The onsite storage plant controller will prevent the two resources from exceeding the project Interconnection Limit.

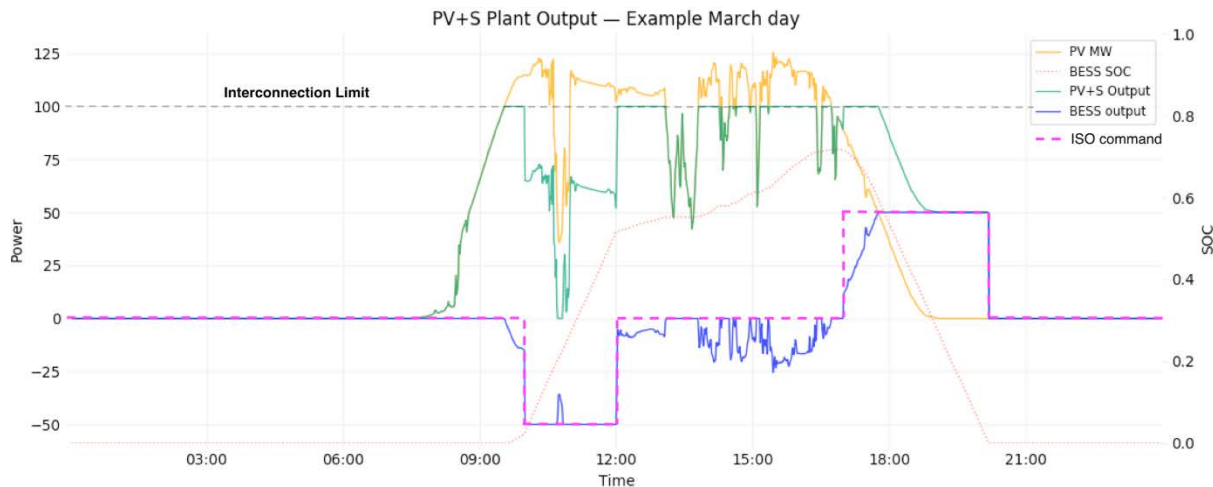


- Forecast error is managed in each timestep by providing a forecast range with probability
- BESS controls are designed to adapt to the new forecast every minute and not overcommit to an uncertain forecast



Controls to accommodate “AC-oversized” plants

An AC-oversized project is one in which the solar generation is intentionally built larger than the Interconnection Limit and a storage system is included to capture energy generated in excess of the Interconnection Limit then discharge it when the solar generation is less than the Interconnection Limit. See the below illustration:



SUGGESTED POLICY:

The ISO should not make the excess generation the “marginal unit” for the local LMP and this should not have any impact on local price because it is managed inside the Hybrid Resource. In addition: (1) The Pmax of the solar resource in the ISO Master File should be allowed to exceed the Interconnection Limit; and (2) the applicable Resource IDs should be linked in the Master File to ensure that the market awards less on-site charging do not exceed the Interconnection Limit.

The ISO should accommodate the following control options for this type of Hybrid Resource.

- (a) The existing Hybrid Resource Constraint should include the option for the energy storage system to self-schedule charge of PV generation in excess of the Interconnection Limit instead of allowing the PV to be curtailed.
- (b) The solar onsite plant controller should report via telemetry the current solar generation and the potential solar generation. Potential solar generation being the solar generation without any economic curtailment or Interconnection Limit curtailment. If the potential solar generation is greater than the Interconnection Limit and the storage facility can absorb it, the ISO should instruct the storage resource to charge from excess generation.

EIR Status of PV in a DC Coupled Hybrid Plant

CAISO does not currently have a DC revenue quality meter. Therefore, the current Single Resource ID treatment from CAISO appears to eliminate the possibility of EIR status for PV in a DC coupled hybrid plant. This technology is an important next step in hybrid PV plants and losing EIR status would make operation of the plant considerably more difficult to the point of preventing investment in these projects. The CAISO’s justification for eliminating EIR status in this scenario is that they can no longer predict the output of the plant and the energy from the PV can be stored on-site. However, often only a small portion of the PV output can be stored in the on-site batteries.

SUGGESTED POLICY: CAISO should be able to solve for the net output of a renewables plus storage Hybrid Resource with a single resource ID by decomposing the resource and then dispatching it as a single resource or solving other methods to solve for dispatch of a since resource ID Hybrid Resource. The MESA-ESS working group along with the associated DNP3 App Note for dispatch of storage provides a clear path from control of a Hybrid Resource with a single resource ID. 8minute commissioned a pilot 3 MW PV plus 1.5 MW storage project in 2019 to dispatch as a single resource with LADWP. 8minute could share lessons learned from this pilot that may be applicable to the CAISO.

Changes to Power Control Equipment

The issue paper defines a requirement for control equipment to limit the output of a hybrid resource to the GIA capacity, “The CAISO and Participating TO must be able to rely on such a device working consistently. As such, the Interconnection Customer may not modify it.”

SUGGESTED POLICY: It would be more helpful to clarify the modification process rather than say that it cannot be modified, which may be overstating what the CAISO intends. For example, modifications should be allowed through the regular process for such changes, in the LGIA (operating projects) or the GIDAP (projects under development).

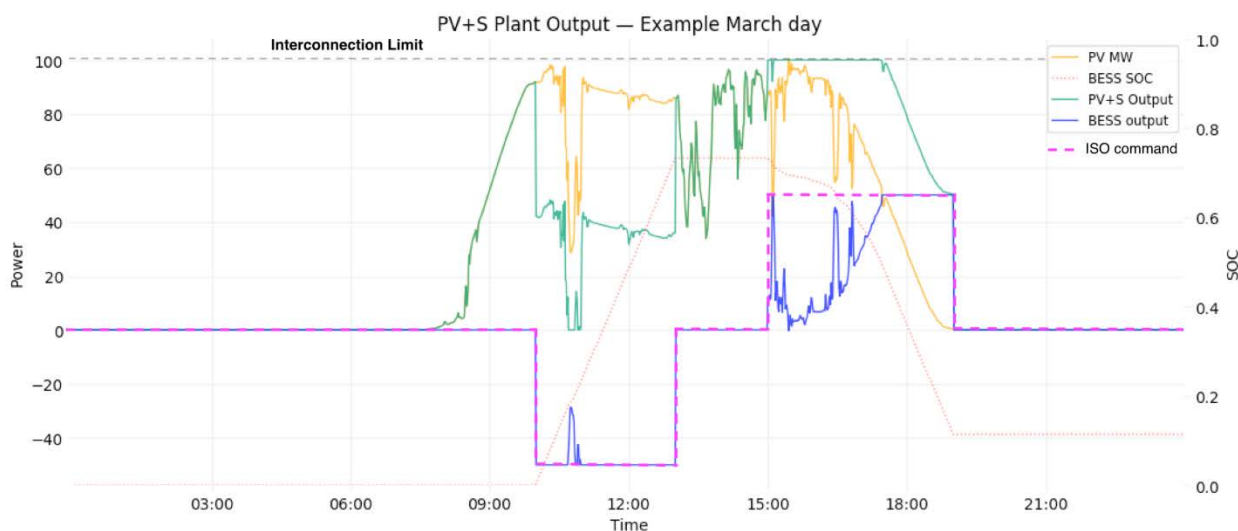
3. Markets and Systems

Please provide your organization's feedback on the markets and systems topics as described in section 3.4.

Project substation & gen-tie treatment as a hybrid resource constraint with lower priced resource allowed to generate if there is a conflict

8minute believes a project can accommodate two separate resource ID's for the PV and storage in most circumstances if the hybrid resources can be dispatched in such a way as to allow both resources to have a Pmax up to the Interconnection Limit. In this scenario an on-site controller would be used to prevent the combination of resources from ever exceeding the total Interconnection Limit.

Under this hybrid resource constraint paradigm the lower bid resource would have preference for discharge/generate. In the graph below it shows an example day where the PV has bid - \$15/MWh for generation due to its ability to capture \$15/MWh for Renewable Energy Credits. The BESS has bid \$50/MWh for discharge which clears at 3 PM (15:00).



In this example, the PV has a lower bid price and therefore has the priority to generate. The on-site controller will monitor the LGIA constraint at the project substation and discharge on a second-by-second basis to fill the Interconnection Limit since it has cleared in the market. The

result is CAISO sees a steady output at the project Point of Delivery (POD) for these hybrid and conflicting resources and the stored energy is preserved for later in the day.

In an alternative scenario the renewable resource generation could always be prioritized but this may cause storage to be curtailed if it is performing high value ancillary services like reg up. In no case should the storage be penalized for failing to discharge on command if the hybrid resource Interconnect Limit allows a Variable Energy Resource to generate as a priority over the stored energy.

SUGGESTED POLICY:

The hybrid resources can be dispatched in such a way as to allow both resources to have a Pmax up to the Interconnection Limit with an on-site controller to prevent the combination of resources from ever exceeding the total Interconnection Limit.

The Hybrid Resource Constraint should result in the co-optimization of the hybrid facility to use the combined capacity and energy in the most profit maximizing way for the PV+S as a single Hybrid Resource. The co-optimization should be performed including at a minimum the following inputs: PV energy and capacity offers, Storage energy and capacity offers, and the grid-charging constraint.

If the PV generation plus storage discharge command is greater than the Interconnection Limit then the onsite controller shall be instructed to either (a) always prioritize generation from the lower price resource, or (b) always prioritize generation from the renewable resource.

If the PV generates in place of dispatched storage then PV will effectively be compensated for energy that was not delivered by the storage. **This is equivalent to the facility being dispatched separately but being settled as a “net” output of the two resources.** If the storage is dispatched but can't discharge due to PV generation filling the Interconnection Limit then the storage will not be compensated for the energy it should have delivered but it will not face other penalties.

4. Ancillary Services

Please provide your organization's feedback on the ancillary services topic as described in section 3.5.

The rules for Spin or Regulation need to clearly defined how many minutes of energy must be installed or how many minutes of energy need to be reserved for this function to maintain eligible for these services.

5. Deliverability

Please provide your organization's feedback on the deliverability topic as described in section 3.6.

6. Resource Adequacy

Please provide your organization's feedback on the resource adequacy topic as described in section 3.7.

Determination of RA Value

Restricting a hybrid plant to only receive RA status for the FCDS capacity divided between its two resources doesn't accurately reflect the reality that a hybrid plant has more ability to meet CAISO operational needs than only a PV or BESS would if alone. I.e., a hybrid plant with 100MW FCDS should have more RA value than a PV with 50MW FCDS and a BESS with 50MW FCDS or any other combination of the FCDS capacity when divided between the two technologies.

SUGGESTED POLICY: There should be a new methodology for valuing RA for hybrid projects. Without this new methodology, the CAISO runs the risk of not properly incentivizing the development of hybrid projects according to their benefit to Resource Adequacy. 8minute supports the methodology discussed in the Large-scale Solar Association (LSA) comments.

7. Metering, Telemetry and Settlements

Please provide your organization's feedback on the metering, telemetry and settlements topics as described in section 3.8.

EIR Status of PV in a DC Coupled Hybrid Plant

CAISO does not currently have a DC revenue quality meter. Therefore, the current charging configurations appears to eliminate the possibility of EIR status for PV in a DC coupled hybrid plant. This technology is an important next step in hybrid PV plants and losing EIR status would make operation of the plant considerably more difficult to the point of preventing investment in these projects. The CAISO's justification for eliminating EIR status in this scenario is that they can no longer predict the output of the plant and the energy from the PV can be stored on-site. However, often only a small portion of the PV output can be stored in the on-site batteries.

SUGGESTED POLICY: A PV plus storage project with a single resource ID should be allowed to retain EIR status if the projects performs its own forecast and then adds the self-scheduled storage charge or discharge to the forecast. This should especially be allowed if the onsite resource uses high quality onsite solar generation forecasts that would make this total solution more accurate than the existing process for forecasting solar PV generation.

8. Additional comments

Please offer any other feedback your organization would like to provide on the Hybrid Resources Issue Paper.