California ISO

Frequently Asked Questions for the High Sustainable Limit (HSL)

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Contents

General

What is HSL?

The High Sustainable Limit (HSL) is the instantaneous generating capability of a variable or intermittent Generating Unit or component thereof, updated through telemetry at the Generating Unit. The HSL is sent to the ISO as a calculated, telemetered value, and represents the approximate weather-based energy output capability of the resource at that moment in time.

The HSL is a real-time estimate of the maximum output capability of a Variable Energy Resource (VER) based solely on the resource's physical properties (i.e. number of solar panels or wind turbines, and available inverters) and the fuel available to the resource based on current weather conditions. The number of available inverters will be determined based on the number of inverters that are available for market participation. The VER may be a standalone unit, a component of a Hybrid resource, or a Co-Located resource. It is a calculated estimate; not a forecast. While the HSL can exceed the Pmax of the resource defined in the ISO's Master File, it should not exceed the site AC capacity.

How does it compare to traditional telemetry?

Unlike traditional telemetry, the HSL is a calculated point that will represent the maximum potential generation at any given time. The HSL will not include any market dispatch impacts, such as supplemental dispatch, ancillary services (AS), or battery charging, in the value. For example, a site is generating at 100 MW and receives a 30 MW curtailment. Once the resource responds to the curtailment and moves down to 70MW, the point of delivery (POD) telemetry the CAISO receives would be 70 MW while the HSL remains at 100 MW. This will allow the CAISO to continue to have good telemetry values to create the forecast during times of market dispatches or follow dispatch operating target (DOT) instructions.

CAISO expects that when telemetry quality is good and there is no supplemental dispatch present, HSL and telemetry are approximately equal. The exception to this statement is when the resource is "overbuilt," where generating capacity exceeds a generating unit Pmax or aggregate capability constraint (ACC), then HSL is expected to be greater than telemetry when generation is near unit Pmax. More detail for this exception is provided in the overbuilt resource discussion.

What resource types is HSL required for?

At this time, HSL is required for Co-Located renewable resources, Hybrid renewable components, and VERs wanting to provide AS. This includes resources within the CAISO BAA, as well as WEIM EIRs as well.

Are stand-alone solar or wind resources or WEIM VERs able to provide HSL?

The ISO strongly encourages all VERs to provide HSL as it has shown to improve forecast accuracy, especially for resources that receive frequent market dispatches, including supplemental dispatches.

Is HSL required for solar thermal units?

At this time, HSL is not required for solar thermal units due to their unique configuration. We encourage solar thermal resources to start a discussion with the Short-Term Forecasting and EDAS teams at the CAISO to determine if HSL is something this resource could provide. Based on this discussion and the site's setup, we can determine if HSL would be beneficial to provide.

Do other entities have a similar requirement?

HSL is similar to potential power utilized in forecasting throughout other regions and HSL within ERCOT.

Are there any other publicly posted documents that provide details on the HSL?

Yes. When the HSL was first introduced as a part of the Hybrid Project a white paper was published detailing the use and need of the HSL. It is available here.

What Tariff or BPM sections reference HSL?

Sections 4.18 and 34.1.6.3 of the Tariff discuss the use and need of the HSL with regards to Hybrid Resources.

The Tariff definition of the HSL is provided in Appendix A. Appendix Q of the Tariff provides details on the requirements for Co-Located resources. Details regarding the requirement of HSL for VERs wanting to provide Ancillary Service are in Appendix K of the Tariff, section A.1.2.2.5.

Within the Direct Telemetry Business Practice Manual (BPM), HSL is discussed in the sections 6, 8 and 14.1.15. Market Operations BPM discusses HSL in Section 2.1.20.

Calculation

Is there a formula for HSL?

The CAISO does not provide an explicit formula for HSL as it is unique to each site based on the configuration and setup of the site and will look different for each resource. Below are the general pieces that should be included into the HSL forecast.

$$Wind: Site\ Output * number\ of\ turbines\ available - electrical\ losses$$

$$Solar: Site\ Output * number\ of\ inverters\ available - electrical\ losses$$

- "*Site Output*" refers to the calculated output in MW of an individual site's power curve given available fuel, either a solar site's average irradiance or a wind site's average wind speed.

- "*Available*" refers to the number of inverters/turbines that are available for market participation. The count should include equipment that is available for dispatch but is not online or not generating at that given time.

What if my resource is overbuilt?

An overbuilt resource is a hybrid or co-located VER unit with MW generation capacity greater than its point of interconnection (POI) or aggregate capability constraint (ACC). HSL should reflect the true generation capability of the resource **without any limitations**. Limitations include, but are not limited to, the point of interconnection (POI), ACC, the defined Pmax in Master File and any transmission constraints. For example, a solar resource has a point of interconnection (POI) of 150 MW, but is built to a 200 MW AC capacity. While the generation will be limited to 150 MW, as that is the maximum the resource can put on the grid, the CAISO needs the HSL to reflect the full generation capacity up to the 200 MW. This is so the forecast providers can accurately capture the ramps and generation of the resource and best provide the value possible to produce given the current weather conditions. For hybrid renewable components, this can be particularly useful to allow the ISO to create a forecast up to the true capability of the VER component without any limitations (including the Pmax in Master File) to allow the SC to better optimize the resource.

How is HSL reported to the ISO?

HSL will be reported through the RIG in the same manner as current MW telemetry and meteorological station information. The HSL information should be transmitted as quickly as possible to minimize the amount of lag in forecast processes. It has been shown that HSL can be sent as frequently as 4-seconds; however, Appendix Q of the tariff specifies that the HSL be sent at a 12-second frequency. Each VER component of a Hybrid Resource must provide their own HSL value, just as they will be expected to provide their own MW telemetry and meteorological information.

My resource doesn't have a back panel temperature, could this impact the HSL?

There is no explicit formula for HSL that will cover all of the various resource configurations. If the resource has determined that back panel temperature is critical in determining the HSL value, but the site does not have a back panel sensor, then other site data, such as ambient temperature and wind speed, should be used to create a calculated back panel temperature to use in the HSL value.

Use and Need

What is the HSL used for?

From the forecasting perspective, the HSL data will be sent to forecast providers to supply them with the generating capability of the VER component of a resource. Currently, when the MW telemetry is impacted by supplemental dispatch or "follow DOT" instructions, this data cannot be used to create the real-time forecast. Instead, vendors must rely only on the meteorological station information and/or characteristics of the resource, i.e. location and panel characteristics for solar or turbine information for wind.

How can providing HSL improve the VER forecast?

The HSL data will allow the real-time forecast to continue to have an approximate weather-based MW capability as an input during periods of battery charging/discharging, supplemental dispatch, AS or operating instructions, instead of having to exclude the MW telemetry in the forecasting methodology. This will lead to an increase in the number of good data periods to use in the historical training sets of resources as well as in the real-time forecast during these periods. In addition to improving the real-time forecast methodologies, the CAISO anticipates the use of HSL will improve the fifteen minute market (FMM) and day-ahead (DA) forecasts as well, due to a significant increase the amount of good data to use in the forecast training for all forecast horizons.

There is also the availability for the HSL to be fed into the Persistence forecast methodology in RTD instead of using traditional telemetry. This is available for standalone and Co-Located renewable resources within the CAISO and WEIMs, but not for Hybrid renewable components at this time.

How can not providing HSL or having HSL quality issues impact my forecast?

By not providing HSL for a resource that frequently receives market instructions, or if HSL is of bad quality for a prolonged period of time, then the VER forecast will need to be based off of resource properties, historical generation data and the latest weather forecast. This reconstruction of generating capability is less accurate than HSL telemetry and could lead to reduced forecast accuracy.

How soon after providing HSL can I see it incorporated into my forecast?

This will vary by resource depending on the quality of the HSL data, length of time HSL has been provided, length of time the resource has been commercial or participating in the market, and the resource fuel type.

For resources that have been participating in the market for years, it will take a longer period of good quality HSL data feeding into the forecast for it to adjust; however, during periods of must follow DOT, resources could expect to see an improvement quicker. For resources that are just going commercial and will provide HSL from the beginning of their operations, HSL will have more of an impact on the forecast more quickly.

Hybrid component VERs utilize HSL as their main telemetry point for which the forecast is formed, versus standalone or Co-Located resources which can also utilize telemetry. If the HSL point is not of good quality, then this could have more of an impact on a Hybrid component forecast as a result.

In all instances, it is crucial for the HSL to remain of good quality to allow it to feed into the forecast. Good quality HSL will be values that are updating frequently, equal to or greater than the point of deliver telemetry, reasonable given the observed irradiance or wind speed, and within range of the resources generating capability. If the HSL value is stale, out of range or zero, then it will not be utilized in any forecast methodology.

Is the HSL data used in any market products or dispatches?

While the HSL is not used directly by the market for any dispatches, it can be used to feed the persistence forecast in RTD for standalone or Co-Located VERs instead of traditional telemetry. This will allow for HSL persistence to remain on during periods of follow DOT instructions. Currently, Hybrid VER components are not eligible for HSL persistence or traditional telemetry-based persistence.

Configuration

What is the process for current resources to add HSL as an additional point if they already have a RIG configuration?

The project manager needs to open a RIG reconfiguration RIMS project, implement the point on the RIG after the RIG points spreadsheet has been received from EDAS, and schedule the fieldwork appointment for final testing. The process is outlined in the "Adding Points to a RIG" appendix section of the Fieldwork Guide: http://www.caiso.com/Documents/FieldworkGuide.pdf

When is my resource required to provide HSL if it will be Co-Located in the future, but is currently not Co-Located?

HSL is required to be provided or an active telemetry exemption to be in place for the resource to change to Co-Located in the ISO's Master File. If a VER is onboarding and knows that in the future that the resource will be Co-Located, the ISO strongly recommends for the VER to begin the process of adding HSL during the initial set up and configuration to avoid delays and potential additional costs later in the process.

Quality

What happens if my HSL point is in bad quality?

According to Direct Telemetry BPM Section 7.3.3:

The Participating Generator is solely responsible for the completeness and accuracy of all information transmitted by a resource to the Real-Time Device. The ISO will not be responsible for the quality of the data transmitted through the Real-Time Device; the ISO will only validate this information for accuracy. The ISO and the Participating Generator must monitor the Participating Generator's data transmitted through the Real-Time Device and, upon observation of any problems with that data, either party must provide the other party notice of the problem and both must work together to correct the problem.

The resource will be subject to the telemetry non-compliance process if the HSL point is reporting invalid values or bad quality. Depending on the resource size, from the date of the notification, the site will have either 5 business days (for resources above 45MW) or 14 business days (for resources under 45MW) to resolve the issue. Failure to submit a telemetry exemption before the deadline will result in fines of $500 per day. This process is further outlined in the Direct Telemetry BPM section 8.4.2.

Bad quality includes, but is not limited to, the connection to the RIG or HSL point is offline, the HSL value is flatlined or out of range, not providing consistent updates or the HSL value is less than the point of delivery telemetry.

How will an inverter or turbine being down impact my HSL value?

If at least one of the inverters/turbines is online, producing, and in good communication, then the HSL values should be updating and the HSL quality should be reported as good/normal.

- If the equipment is turned off (offline) but is available for generation, then the HSL should still account for those devices and include them in the capacity calculation. An example of this situation is when an inverter is turned off to respond to a dispatch signal (standby mode), but the inverter is available for generation and can be turned on.

- If the equipment is turned off (offline) and is not available for generation, then the HSL should omit those devices and exclude them from the capacity calculation. For example, if the inverter is being serviced, is in good communication, and is out of operation, then that inverter is not dispatchable and should not be included in the HSL calculation. An accompanying OMS derate should be in effect in this situation.

- If the equipment is in a bad communication state but is available for generation, then the HSL should still account for those devices and include them in the capacity calculation. For example, if a specific inverter is in bad communication with a site SCADA controller, RTAC, PLC, or RIG but is available for generation, HSL calculation should include this inverter.

- If the equipment is in a bad communication state and is not available for generation, then the HSL should omit those devices and exclude them from the capacity calculation. For example, the inverter is being serviced, is in bad communication, and is

out of operation, then that inverter is not dispatchable and should not be included in the HSL calculation. An accompanying OMS derate should be in effect in this situation.

What should be the impact to the HSL if some or all weather stations are not communicating/bad quality?

The CAISO usually requests telemetry for two of the weather stations for a resource. If there are weather stations that are available but are not being telemetered by CAISO, those additional weather stations may be included in the HSL calculation. If at least one of the weather stations mapped to the HSL is online and in good communication, then the HSL values should be updating and the HSL quality should be reported as good/normal. If all weather values mapped to the HSL calculation are erroneous, an "invalid" HSL quality can be reported. For example, if the site has two met stations, each with irradiance values, and all irradiance points are reporting offline, then the HSL point should report a bad quality flag.

If my resource has an outage in place, will that be reflected in my HSL value?

If the outage is due to inverters or turbines being down, offline, or unavailable for market participation, then yes, the HSL value reported should include the impacts of the outage. However, depending on whether or not the resource is overbuilt, the HSL value may not be the same value as the point of delivery MW telemetry value during the outage. Our forecast vendors receive outage information and will incorporate this information into their forecast training.

Should the HSL value include impacts due to supplemental dispatch if the resource uses the inverters to respond to market dispatches?

If the resource is being curtailed or is receiving a supplemental dispatch, the HSL should still report the true potential generation capacity.

Is there a data accuracy requirement?

The CAISO performs checks on the HSL value to ensure it is reasonable. Our primary check is that the HSL is greater than or equal to the POD generation value because the HSL should be indicative of what the site can produce given the weather conditions, so it should always be at least equal to what the site is actually producing. We do compare the HSL value to the generation capability of the VER portion given the current weather conditions (and time of year for solar) to check that the value is reasonable, as well as compare to the wind speed for wind resources and irradiance for solar resources.

The CAISO continues to evaluate HSL and plans to expand on data accuracy requirements in the future.