



California High-Speed Rail **BRIEFING: August 24, 2023 Board Meeting** **Agenda Item #4**

TO: Chairman Richard and Board Members

FROM: Margaret Cederoth, Director of Planning and Sustainability

DATE: August 24, 2023

RE: Battery Storage and Solar Generation Strategy Update

Summary

This document outlines the history of the Authority's Board-lead commitment to 100% renewable energy for operations, the progress of technical analysis to achieve that commitment and discussions with key stakeholders. This memo also identifies next steps and decisions ahead of the board to procure resources in a manner that results in reduced operational costs and system resilience.

Background and Prior Board Discussion

In 2008, based on a technical analysis as to the feasibility of running the system on renewable energy, the Board committed to a policy goal of running the system entirely on renewable energy.

"The adopted language is as follows: "The California High-Speed Rail Authority's policy is to power the train with clean renewable energy, making it the first true zero-emission train in the world." *Board Action:*

http://archive.hsr.ca.gov/docs/brdmeetings/2008/brdmtg0908_min.pdf

Since then, the Board has periodically reinforced this commitment in several policy actions, either specific to sustainability and renewable energy, or in its consideration and adoption of biannual Business Plans.

In 2012, the National Renewable Energy Lab NREL completed a [Strategic Energy Plan](#) for the Authority, that examined the logic and technical feasibility of a net-zero approach to the renewable energy commitment. The process of developing a strategic energy plan involved broad stakeholder consultation with environmental organizations as well as state and federal partners who emphasized additional policy drivers including reducing operating costs, additionality, and avoiding a strategy that relied entirely on renewable energy credits (RECs).

The Strategic Energy Plan was presented to the board in January 2012. In 2013, the Authority developed a Sustainability Policy in which the commitment to operations relying on renewable energy was a core focus and which drew directly on the extensive research undertaken for the Authority by NREL.

In 2016, [Board Resolution #HSRA 16-05](#) noted the Authority has committed to 100% renewable energy, or net-zero energy and carbon, for train operations. This resolution adopted the revised sustainability policy, which focused on a net-zero approach to the renewable energy commitment. The policy revisions drew on market and stakeholder engagement in 2014-2015 ([Call to Industry](#)) that examined the state of the California renewable energy industry as well as existing regulation and statutory mandates. The Authority also entered into an [MOU with the California Energy Commission](#). Staff work was focused both on understanding the dynamics of the Authority load as well as analyzing the opportunity for the Authority to participate in the wholesale market, to achieve its renewable energy goal while also reducing operating costs. The intricacies of wholesale market participation required close analysis of load-serving entity authorities and responsibilities.

In 2019, with [Resolution #HSRA 19-02](#), the commitment in policy was still to operate the system on 100% renewable energy and the resolution noted the Authority has committed to 100% renewable energy, or net-zero energy and carbon, for train operations. The Board memo noted that staff work on renewable energy included analyzing the system for optimal locations for energy storage and means to reduce operating costs. Given the opportunity presented by adjustments to the net energy metering tariff in 2016, behind-the-meter resources to meet the Authority's renewable energy commitment while also reducing operating costs had become feasible.

In October 2020, in the presentation of the Annual Sustainability report, the [Board Memo](#) noted that staff work on renewable energy had continued with refining the study of Authority parcels for renewable energy generation and developing an approach to energy storage and renewable energy. The [April 2021](#) presentation to the board on the Authority's commitment under the sustainability policy to require ZEV equipment for on-road fleets included discussion of staff work analyzing the opportunity of using solar and batteries behind-the-meter to reduce costs and mitigate risks. A similar update was provided in the [September 2021](#) Board Memo on the annual Sustainability Report. Most recently, in October 2022, as part of an update on the annual Sustainability Report, [the Board Memo](#) noted that staff work had included continued analysis of a behind-the-meter strategy for traction power supply, and continuing to confirm the details of a logical, cost-effective approach. This includes optimizing the size of batteries to enable a range of operating scenarios and configuring the proposal into the Authority program. A more detailed discussion of the staff work, including cross functional

collaboration with rail engineering and the possibility of seeking grant funding, was described in the [2022 Sustainability Report](#) (Page 28).

Legislation and Regulatory Action

In September 2022, California Senate Bill 1020, the Clean Energy, Jobs, and Affordability Act of 2022, directed that Section 454.53 of the Public Utilities Code be amended to include a provision that eligible renewable energy resources and zero-carbon resources supply 100 percent of electricity procured to serve all state agencies by December 31, 2035.

In April 2023, the California Public Utilities Commission (CPUC) adopted a successor tariff to the net energy metering (NEM) tariffs, a new net billing tariff (NBT). The NBT still allows for compensation for excess generation exported to the grid and is structured to encourage customer-generators to install battery storage to maximize bill savings.

Discussion: Summary of Current Technical Strategy

As detailed in the background above, since 2019, while still monitoring and evaluating other options, staff have focused on a behind-the-meter strategy for achieving the Authority's renewable energy operations commitment. The behind-the-meter strategy includes:

1. Siting solar photovoltaic (PV) arrays on land already owned by the Authority to generate renewable energy. Currently, the solar PV arrays are optimally sized to reach net-zero annually against the network load.
2. Linking the solar PV arrays, via the alignment, to battery storage at the traction power substation locations (TPSS) and utility interconnections.
3. Integrating the battery storage resources with the traction power substation equipment.
4. Scaling the battery storage to enable peak shaving and provide a source of reserve power for the system to draw on in the event of planned and unplanned grid outage events.

The behind-the-meter resources are currently designed as the primary power source for the system infrastructure with the utility connection to be used in periods of low sunlight or contingency situations. Static Frequency Converters (SFC) will be used to allow 3-phase interconnection of the utility and behind-the-meter resources.

Benefits of this strategy include:

- Reduction of annual energy-related operating costs of, potentially, 75%, which could save more than \$10 million dollars annually.
- Provision of reserve power for train operations.
- Provision of grid benefits, as discussed in detail below:

- Provide a more balanced load profile to the grid with the use of a three-phase service as compared to use of a single-phase service (typical for electrified rail systems).
- Create the opportunity to support the grid during times of high congestion to prevent brown outs or black outs through coordination with the local electric utility company by using the battery storage and solar PV resources to supply capacity to the grid during times when energy is most required, 4-9 P.M.
- Significantly reduce the peak energy demand.
- Reduce the load required of the transmission system overall, and significantly reduce the intermittency of the load and generation, using the batteries to store and release energy as required to present a more level load profile to the grid.

Technical Analyses Underpinning Current Strategy

As previously mentioned, staff work since 2008 has focused on the analysis of the Authority's renewable policy. Since 2008, the broad regulatory context of renewable energy in the State has shifted considerably, specifically for State agencies, including technical context of energy storage and climate resilience. California policy has focused increasingly on broad state decarbonization by 2045, with key milestones in 2035. There has been a continued tight focus on utility-specific renewable energy generation requirements. Electricity tariffs that accommodate the scale of the high-speed rail system have emerged and evolved.

Staff work has adjusted with these changes, while keeping a focus on the core policy goal of 100% clean, renewable energy for system operations. The other critical driver for staff work has been achieving this goal while also reducing operating costs, given the aim to operate the system without subsidy.

As discussed in Board Resolution #HSRA 16-26, in which the Board approved staff to enter into a contract with Pacific Gas & Electric (PG&E) for engineering and permits associated with electrical interconnections, the high-speed rail system is designed to be powered by a 25kV AC Auto-transformer traction power network, with traction power sub-stations (TPSS) located approximately every 30 miles.

In addition to advancing the studies necessary for interconnection with PG&E, Authority staff conducted a thorough feasibility study on solar PV and battery energy storage systems (battery storage) consisting of three separate phases of analysis:

Phase 1: creation of a comprehensive projection (model) of energy consumption at each TPSS in the Merced to Bakersfield segment at 15-minute increments using the anticipated train model, train schedule, and physics of the train route;

Phase 2: determination of optimal grid interconnection configuration and tariffs to identify the best approach to working with the local electric utility company (PG&E in the Merced to Bakersfield segment);

Phase 3: creation of detailed and refined projections of project economics using tariffs and schedules (or rates) provided by the local electric utility company to confirm the financial viability of the proposed projects.

The technical work underpinning the current strategy also includes:

- Detailed analysis of the Authority’s right-of-way portfolio (within the first 119 miles of construction) for suitability for energy generation. To date, this analysis has focused on solar generation, given the project’s location in the Central Valley. This geographic information systems (GIS)-based analysis looked for parcels of a greater than 5-acre size and useful configuration (square) that were in proximity to traction power substation locations. These parcels were also screened for fatal flaws including slope and floodplain.
- Understanding the Authority’s operations profile, including requirements for system reliability.

The team has utilized these inputs to size battery storage adjacent to the traction power substations in the Merced to Bakersfield segment. In the case of the Authority’s planned systems, the combined solar PV and battery storage are sized and configured to ensure that a minimum of six (6) hours of backup power can be provided even during winter conditions when the solar PV system would be anticipated to produce the least amount of energy. To reliably provide backup power, the battery storage is also sized to ensure that the instantaneous power draw from the rail system can be met with the kilowatt rated output of the inverters associated with the batteries. In the first iteration of this work, the kilowatt-hour ratings of the battery storage were optimized at two (2) hour durations given the large size of the associated solar PV systems. Further optimization of battery storage sizing and technologies are expected in the next phase of work, given the rapid advancements of the industry in recent years.

The strategy under consideration is anticipated to allow for real-time load-to-generation matching that minimizes exports to the grid and facilitates the availability of the solar PV and battery storage to support the grid for both energy supply and ancillary services as a demand response resource for additional revenue potential. The Authority is well positioned to support California’s energy transition through deployment of solar PV, battery storage, and electric trains as flexible and smart resources that are programmable, responsive, and monetizable in the California retail and wholesale power markets.

The Authority has included the battery storage and solar PV technical considerations and physical locations, where known, into the configured system and system baseline.

Consultation with Key Stakeholders

Over the past decade, Authority has engaged with several state and regulatory agencies as well as the independently owned utility that operates the transmission system with which the Authority will interconnect.

The California Public Utilities Commission (CPUC) oversees the implementation of state policy relative to electricity tariffs. The Authority has met periodically with the CPUC, with greater frequency in the past 18 months to confer on Authority requirements, the behind-the-meter strategy, and to review the potential consequences of legislative policy initiatives relative to renewable energy tariffs and CPUC rules.

California Independent Systems Operator (CAISO). The solar PV and battery storage are designed to accommodate the requirements of the CAISO relative to transparency and telemetry and provide a source of back-up power both for the high-speed rail system and for adjacent facilities to provide additional community resilience. The Authority has periodically briefed the CAISO on the project load and load profile, most recently in May of 2022.

Pacific Gas & Electric (PG&E). The Authority has been working with PG&E since 2014, on a standard approach to transmission interconnection. These discussions have focused on the formal agreements the Authority has had with PG&E relative to load forecasting and the requirements of transmission interconnection at traction power substation locations. In 2019, to meet key goals of the high-speed rail program and in response to PG&E interest, the team intensified discussions of alternative approaches of supply that could better address critical grid resilience and system reliability goals. Recent discussions have included detailed review of the changes to load profile with battery electric storage. A reliable, resilient, and renewable energy supply approach addresses both high-speed rail power supply needs and critical grid resilience and system reliability performance.

California Energy Commission (CEC). The Authority has met periodically with CEC Commissioners and staff to review the Authority's renewable energy goal, confer on market conditions and industry readiness, and understand the opportunities of emerging state policy relative to the Authority's strategy.

Department of General Services (DGS). The Department of General Services Office of Sustainability Clean Energy Unit supports state departments interested in onsite renewable energy generation through site license agreements (SLA) and power purchase agreements (PPA). SB 1020 and AB 1279 as well as changes to CPUC Rule 21 have influenced DGS's approach to mandatory requirements. The Authority has ongoing meetings with DGS to review and discuss its behind-the-meter strategy.

Governor's Office of Business and Economic Development (GoBIZ). GoBIZ has focused in the past years on coordinating state agency approaches to zero emissions vehicles, hydrogen fueling, and federal requests. The Authority has participated in ZEV working groups since 2015, as well as contributing to the State's ZEV Market Development Strategy. The high-speed rail system plays a unique role in the State as the highest capacity, fastest ZEV in development; the behind-the-meter supply for high-speed rail enables further resilience and market opportunities for ZEV vehicle charging.

Discussion: Next Steps

As the Authority advances critical steps in project delivery to realize an operating segment at the end of the decade, advancing the behind-the-meter strategy of solar PV and battery storage is critical. These components are best integrated with the traction power system so that they are tested and optimized to work as a single system.

To advance the strategy, the next year includes several core activities:

- Adjust the power load model to flexibly and quickly accommodate consideration of shifting drivers.

As the Authority considers its procurement options, an updated model allows the Authority to explore a range of configurations, adjust model parameters quickly in response to industry information as well as updated Authority information (such as trainsets) as well as communicate the model to prospective contractors and bidders.

- Confirm a procurement strategy.

Staff across functions are in regular consultation on the specific technical dynamics of the behind-the-meter strategy and are considering optimal procurement methods, include design-build, design-build-operate maintain, and other. This work also includes consideration of interfaces among contracts and optimizing these to minimize technical or financial risk.

- Seek sources of funding.

In May 2023, as discussed at the Finance and Audit Committee meeting in June 2023, the Authority applied to the Department of Energy Grid Resilience and Innovation Program (GRIP). Given the unique nature of high-speed rail and its behind-the-meter strategy, and given the operational cost benefit that comes with a capital investment, the Authority has sought new capital dollars to support the behind-the-meter strategy. The GRIP program was an intriguing source of funding because it corresponded to some of the unique characteristics of high-speed rail: battery resources at utility scale, solar generation at utility scale, deployment of these

resources at times of high grid stress. Staff will continue to explore potential funding opportunities.

The HSR system serves as the backbone of electric, interregional travel and is a significant part of California’s climate goals. The behind-the-meter strategy is foundational to achieving those goals.

Legal Approval

This is an informational item on the Authority’s Battery Storage and Solar Strategy, and by itself, does not have a legal impact.

Budget and Fiscal Impact

This is an informational item on the Authority’s Battery Storage and Solar Strategy, and by itself, does not have a budget or fiscal impact.

The cost of solar with battery storage was included in the 2023 Project Update Report in the Merced to Bakersfield cost estimates. In May 2023, the Authority submitted a grant application to fund this cost, requesting \$53.7 million (to be matched with \$53.7 million in State funds) from the United State Department of Energy’s (DOE) Grid Resilience and Innovation Partnerships (GRIP) Program. Grant decisions by DOE are still pending.

REVIEWER INFORMATION	SIGNATURE
Reviewer Name and Title: Alicia Fowler Chief Legal Counsel	Signature verifying legal analysis: Original Signed 8/16/2023
Reviewer Name and Title: Brian Annis Chief Financial Officer	Signature verifying budget analysis: Original Signed 8/16/2023

Recommendations

This is an informational item.