



EV Fleet Resiliency Pathway: Santa Clara Valley Transit Authority



Figure 1: Electric buses charging beneath a solar canopy at VTA's Cerone Yard.

Building a resilient, zero-emission transit fleet

Santa Clara Valley Transportation Authority (VTA) is electrifying its fleet to reduce emissions. VTA is complying with the California Air Resources Board's [Innovative Clean Transit](#) regulation. The regulation requires all California public transit agencies to transition to 100 percent zero-emission bus fleets by 2040. VTA's fleet includes heavy-duty transit buses, work trucks and paratransit vehicles. The paratransit fleet includes wheelchair-accessible minivans. It also includes cutaway buses that serve riders with accessibility needs.

VTA is installing charging equipment for battery-electric buses (BEBs) at two of its three bus yards. Funding comes from the California Energy Commission grant and Caltrans Low Carbon Transit Operations program. VTA ordered 35 battery-electric buses for the Cerone Yard. VTA plans to transition its bus fleet to 30 percent battery electric. The other 70 percent will be hydrogen fuel cell electric vehicles. The agency is also exploring electric options for fleet support vehicles and paratransit vehicles.

VTA provides essential transit services. The agency must be ready for power outages and other emergencies. These events can include Public Safety Power Shutoffs, winter storms, floods and earthquakes. During emergencies, VTA provides rides for evacuations. The agency also helps people reach emergency shelters.

Implement a charging strategy for sites and vehicles

At the Cerone Yard, VTA plans to use bus return times, routes, and departure times to manage overnight charging. VTA selected chargers that allow each BEB to reach a full or near-full state of charge before the next day's service. VTA designed the charging infrastructure with one charging port for each bus. This allows all buses to charge at the same time. It also removes the need for staff to move buses on and off chargers during the night. VTA is implementing charge management software to spread charging throughout the night. This approach aims to reduce peak charging demand and lower electricity costs.

Cerone (under construction)

- **DC Fast Chargers** (90-180 kW per port for BEBs)
- **Power Cabinets** (1.44 MW per cabinet)

Chaboya (in planning)

- **DC Fast Chargers** (BEBs)
- **Level 2 AC Chargers** (medium- and light-duty vehicles)

At the Cerone Yard, VTA is installing two power cabinets that supply power to the charging ports. Each cabinet serves about half of the yard's charging ports. VTA chose large power cabinets instead of single chargers. This reduces the space the equipment takes up on site. The cabinets contain several power modules. If one module stops working, the others can continue operating. This setup allows VTA to continue charging and operating part of its fleet even when part of the equipment fails.

Design resiliency solutions

Start with your power needs

To determine how much power an EV fleet site needs, VTA took the following steps:



Develop energy demand models based on fleet schedules and routes

VTA developed energy demand models using bus schedules and assigned routes. The models also considered the expected state of charge (the percentage of battery charge remaining) when buses return to the depot at the end of their shifts. The models estimate how much energy the fleet needs during an outage to recharge all buses for the next day of service.



Compare charging need under managed and unmanaged scenarios

VTA reviewed the maximum amount of electricity the charging system would use at one time (peak demand) under different charging approaches.

With unmanaged charging, all buses can draw power at the same time. This uses the most electricity at once and creates the highest peak demand. That demand could exceed what backup systems can support and could lead to service disruptions during an outage. With managed charging, software schedules charging times based on bus schedules. This reduces the number of buses drawing power at the same time and spreads the charging load. Peak demand is significantly lower with managed charging.

VTA is sizing its backup power systems to support the fleet's managed charging peak demand during an outage. The backup systems have enough capacity to support fleet charging as long as the charge management software is operating. If the software fails, the backup systems can still support part of the fleet to maintain essential service.

Evaluate resiliency technologies

VTA first planned charging and resiliency improvements for the Cerone Yard. During planning, the agency considered mobile generators with cam lock connectors. However, VTA identified a key challenge. Rental generators may not be available during large or widespread outages. At Cerone, VTA is planning a resiliency system that includes solar and a battery energy storage system (BESS), combined with either a mobile natural gas generator connected through a cam lock backup power connection or a permanent natural gas generator.

For the Chaboya Yard, the available budget did not support a permanent on-site resiliency solution. As a result, VTA plans to use mobile generators, which cost less up front. The risk that rental generators may not be available during major outages, identified during Cerone planning, also applies to Chaboya. VTA accepted this tradeoff given budget constraints.



Figure 2: Drawing of the future medium-voltage (MV) switchgear at the Cerone Yard.

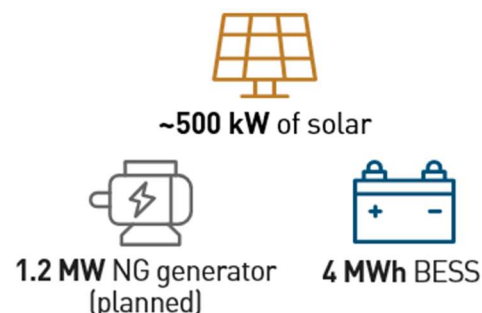
Select technologies for each site

VTA chose different resiliency solutions for the Cerone and Chaboya yards because each site operates on a separate electrical grid. A power outage at one yard would not directly affect the other. This allowed VTA to design each yard's solution to meet that site's needs.

Cerone Yard

At the Cerone Yard, VTA selected a permanent microgrid that includes approximately 500 kW of solar generation, 4 MWh of battery storage, and a planned 1.2 MW natural gas (NG) generator.

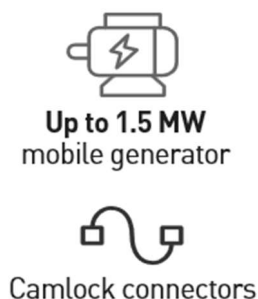
During an outage, the solar and battery system provides immediate backup power. However, this system can only charge part of the fleet when solar production is low, such as during the winter, or when overnight charging demand is high. To help with this, the battery system will be able to charge from both the electric grid and on-site solar panels. For longer outages, the planned natural gas generator will connect to a city natural gas line and provide continuous power. This will help keep all Cerone buses charged at their managed peak demand of about 1 MW.



Chaboya Yard

At the Chaboya Yard, VTA plans to use a mobile generator with cam lock connectors at the charging station. The connectors would support a mobile generator of up to 1.5 MW. This would provide enough backup power during an outage to support about half of the yard's charging demand.

VTA is also designing the Chaboya site for future upgrades. If the Cerone microgrid pilot is successful and funding becomes available, VTA could upgrade the site to a permanent microgrid with solar panels and battery storage. These upgrades could be made without tearing down and rebuilding parts of the site. For example, VTA can design canopy frames now to support future solar installations.



Key takeaways

1 Plan for the long-term and secure funding

EV fleet resiliency projects require coordination and careful cost planning. Public funding through state and federal programs can offset infrastructure costs. VTA's resiliency planning began years in advance and was supported by grants from the California Energy Commission and Caltrans.

2 Align resiliency strategy with company goals

Choose a resiliency solution that supports your core operational needs. VTA's mission requires a reliable fleet for daily transit service and emergency mutual aid. To achieve near zero downtime and maintain operations during outages, VTA selected a permanent microgrid at Cerone. It plans to use mobile generator capability at the Chaboya Yard.

3 Understand your risk tolerance

VTA's mission requires near zero fleet downtime. To support this goal, VTA built redundancy into its charging system across both hardware and software. The Cerone Yard includes two power cabinets with multiple power modules. If one module fails, the others can continue operating, allowing some charging to continue. Charge management software helps optimize charging loads. If the software fails, backup systems will still support part of the fleet and maintain essential service.

4 Test technologies before scale

Test resiliency technologies on a small scale before deploying them at additional sites. This allows agencies to assess performance, effectiveness, costs, and lessons learned. VTA is implementing a microgrid at the Cerone Yard. The results will help determine whether VTA needs to upgrade the Chaboya Yard from its current mobile generator approach to a permanent microgrid.

Prepare your electric vehicle (EV) fleet for power outages with support from PG&E's EV Advisory Services. Contact [PG&E EV Advisory Services](#).



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