Ava Community Energy: Zero-Emission Medium- and Heavy-Duty Goods Movement Blueprint

Attachment 1:

Review of Pilot Projects

May 2022

This document was submitted as a deliverable for California Energy Commission's Agreement Number ARV-21-003 under Task 4 - Assess Product Readiness. The goal of Task 4 is to understand zero-emission vehicle technology readiness across medium-and heavy-duty good movement vocations and applications, and the suitability of charging infrastructure technologies and types.

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Key Takeaways:

- **Start by deploying zero-emission (ZE) medium- and heavy-duty (MDHD) goods movement vehicles on shorter routes.** Currently, this is still the best way to start the transition. ZE MDHD range is likely to be affected by loads, use of air condition and/or heating, and driver behaviors. Modeling routes based on vehicle specifications and baseline operational data can help establish realistic deployment expectations and guide the design of near-term use cases. As more ZE MDHDs become available, it is expected they will operate on longer routes, being fully comparable to diesel long-haul tractors (based on ZETI).
- **Plan for infrastructure ahead of time.** Work with operators, electrical professionals, Load Serving Entities like Ava and investor-owned utilities, and other stakeholders/partners to plan for infrastructure capacity, siting, installation, and O&M. Install charging infrastructure where MDHDs park as feasible to allow charging during off-shift hours.
- **Plan for charging ahead of time.** Understand electricity rates and cost (e.g. time-of-use electricity cost, demand charges), incentives (e.g., LCFS), and charging optimization options during project planning phase. Consider smart charging to manage costs in addition to utilizing enroute charging hubs for opportunity charging where needed.
- **Allow time for unexpected delays.** The process of deploying new technologies is more likely to come with unexpected technical and mechanical issues. Plan for extra time addressing unexpected mechanical issues on both vehicles and charging infrastructure. Having a local technical support team was found to be helpful to pilot stakeholders.
- **Test reliability before large-scale deployment.** It is nearly impossible to operate a MDHD diesel vehicle in the same way as a ZE MDHD. Use the testing phase to QA/QC trucks' ability to meet fleet operation requirements (e.g., range, payload, needs for charging). Plan to adjust routes, charging schedule and time based on operation.
- **ZE MDHD trucks with lower classes simpler to deploy than others, however success depended on fleet planning based on operational requirements.**
    - Class 6-7 box trucks and walk-in vans have been tested successfully operating between warehouses, distribution centers, and drop-off locations, being a comparable replacement for diesel counterparts. However, it's still recommended to use them for shorter routes and/or in a pilot deployment phase. Planning for opportunity charging in was also key to ensure range requirements were met.
    - ZE drayage and tractors might not be one-for-one replacement for all comparable diesel trucks. Whether a ZE truck is suitable for diesel replacement depends on designated payloads, range, daily number of shifts, and most importantly, a fleets or independent owner-operators ability to accommodate these factors into their operations.

Pilot Project #1: Volvo LIGHTS Project

Volvo LIGHTS deployed on and off-road zero-emission technologies (ZET) and equipment to demonstrate the capability of ZET meeting operational requirements and economic feasibility in the freight sector. Fleets partnered for deployment located in the Los Angeles metropolitan area. Class 7 box trucks and Class 8 tractors were used to move goods between distribution centers. Class 8 drayage delivered freight between San Pedro Bay Ports and inland warehouses.

Electric box trucks were able to meet the duty cycle of diesel counterparts driving up to 120 miles daily while Class 8 tractors and drayage were operated in different duty cycles from the baseline due to range limitations. Class 8 tractors were operated on regional routes between distribution centers with daily range less than 200 miles and returned to base for charging every day. They would not be used for short-haul duty cycles until they reached a range of 300 miles. Because of range anxiety and charging time, Class 8 drayage was operated as a single shift daily while the diesel drayage was used for two shifts. The fleet planned to use the next generation of electric drayage trucks for their regular operational patterns.

Range is still a major concern when deploying current models of MDHD electric trucks. To address this, fleets are recommended to plan enroute or in-depot charging into operations and adjust shift schedule accordingly. For example, drivers in this pilot returned from morning routes between 2-3pm and charged trucks during a 40-min break. They were also advised to monitor the battery's state of charge and take opportunity charging whenever possible, such as plugging in immediately after unloading and before the next shift.

In addition to range consideration, infrastructure and charging needs must be planned carefully during the early stages of deployment. Infrastructure design must consider chargers' spacing requirements, charging frequency, and charging operations. Having onsite backup power like generators and battery energy storage systems can improve operational resilience. Additionally, managing charging to align with driver shifts, demand charges and time-of-use electricity rates may lower operating costs. When planning for infrastructure deployment in general, it is recommended to consider long term charging to enable growth alongside ZE vehicle adoption.

With any new technology, unexpected issues may arise. Fleets should remain actively engaged in monitoring the early phase of their ZE vehicle deployment to proactively respond to issues. Vehicle data collected early on can guide planning, provide insights on duty cycles, and help optimize operations. This also provides an opportunity to identify problems like actual charging capacity or vehicle range being less than rated by OEMs. Another common issue is excessive idling because it is not obvious when a ZE MDHD is fully off. Training is also an important aspect to address from the beginning. Operators need guidance and practice to adapt to the regenerative braking of ZE MDHDs. Maintenance staff also need adequate, hands-on training to safely perform tasks, especially for high voltage components.

Pilot Project #2: Green On-Road Linen Delivery

Green On-Road Linen Delivery evaluated Class 6 battery electric walk-in vans' feasibility for the use case of linen delivery from AmeriPride's main Fresno facility to Stockton, Merced, and Bakersfield. Baseline delivery trucks ran routes of 45-130 miles. Battery electric vans deployed were assigned to the shortest routes that matched their 70-mile range. AmeriPride found that the battery electric vans deployed were prone to breaking down and found it helpful to have local mechanical repair support available from the beginning of the project. Fleets should establish local maintenance and product support to address technology issues early to ensure a smooth transition. Evaluating and testing the battery electric vans' reliability and use case feasibility against business operational requirements was crucial. This process can ensure ZE vehicles meet fleet expectations and allow for duty cycle adjustments accordingly.

In addition to ZE vehicle testing, planning for charging infrastructure and local technology support were found to be important for the overall success of the pilot. Installing infrastructure required early engagement of electrical contractors or engineers who could consider electrical load, local utility capacity, and associated costs.

Pilot Project #3: Goodwill Industries Electric Delivery Vehicle

Deploying 10 Class 6 electric box trucks and a Class 8 electric debris hauler helped Goodwill Industries assess the process, requirements, and costs of transitioning their MDHD diesel fleet to ZE alternatives. The vehicles delivered and hauled goods along short, urban routes. They serviced Goodwill's retail stores and drop-off locations in San Francisco, San Mateo, and Marin counties. The ZE trucks were able to match day-to-day operations, running regular service routes and loading and unloading typical payloads.

Goodwill made thoughtful accommodations as they deployed ZE alternatives which contributed to the vehicles meet the fleets operational expectations. Vehicle specifications and baseline operational data were collected to model and design the most efficient routes for the electric box trucks and debris hauler. Adjustments were made to vehicle routes after initial deployment based on validation testing. To mitigate range anxiety, SFGoodwill implemented opportunity charging midday and modified the electric routes. The fleet also trained drivers on more energy efficient driving by using regenerative braking and avoiding stop-and-go operations. A charging plan was created prior to installation of the charger infrastructure and included evaluation of operational costs (e.g. utility rate assessment, rate modeling, vehicle-energy demand projection and demand charge costs). SFGoodwill moved its operations to a single warehouse in South San Francisco to accommodate the 11 electric vehicles and charging stations. A staggered charging schedule was developed so that a maximum of three chargers operated simultaneously, while accounting for varied route lengths and power needs.

The electric trucks and hauler's operations aligned with their intended duty cycle without any performance concerns. Based on interviews with drivers, the ZE alternative's operational range, payload, and overall performance were comparable to baseline diesel trucks. SFGoodwill did not report any issues with charging infrastructure. Vehicles were fully charged and ready for use at the beginning of each shift.

The total cost of ownership of the electric box trucks was similar if not slightly lower than diesel counterparts while that of the debris hauler was higher. This might be a result of restricted operation due to the pandemic and optimized once trucks begun full operation.

The main challenge identified from this project related to vehicle delays caused by mechanical issues (e.g., outfitting of vehicles by 3rd parties - box truck liftgates, debris hauler tarping system). This resulted in trucks often being unavailable and limited for fleet operations. SFGoodwill found that deploying a small scale, short-term pilot to test the reliability of new technologies in real-world conditions before official deployment was advisable.

Pilot Project #4: Frito Lay Transformative Zero- and Near Zero-Emission Freight Facility

Frito Lay assessed real-world performance of ZE MDHD trucks operating between warehouses and retail locations. Six (6) Class 6 box trucks, with the top towing capacity operated the fleet's shorter routes and their duty cycles involved fulfilling local deliveries and unloading products. These vehicles would then have empty product containers loaded back onto the truck and continue to the next stop. Class 6 electric box trucks were used to replace Class 8 diesel trucks and new routes were designed to accommodate the change. Existing diesel trucks drove on higher milage routes, averaging 250 miles per day, compared to 50 miles per day for the electric trucks. This project is still in progress and lessons learned are not available.

Pilot Project #5: California Collaborative Advanced Technology Drayage Truck Demonstration

The Drayage Truck Demonstration Project was carried out by South Coast Air Quality Management District and deployed 36 Class 8 battery electric drayage trucks across 17 fleets. Each fleet had different feedback on the performance and feasibility of the vehicles. Most fleets experienced range anxiety and operated the battery electric drayage trucks on local routes. Charging time meant the battery electric trucks were used for one shift instead of two in most cases. Heating and the use of air conditioning also influenced vehicle range.

GSC Logistics Inc. operated battery electric drayage trucks locally, with trips averaging 20 miles a day. Their diesel trucks were used between warehouses or cross-state routes with an estimated 60 miles of daily travel. Battery electric trucks operated by GSC could complete routes with lighter loads but had to be towed on two occasions on their way from making trips to local Ports. This was potentially due to heavy loads and/or uphill routes. In addition to the mechanical issues GSC Logistics experienced, other fleets engaged in this pilot experienced also experience vehicle downtime. One truck for example was out of service for over six months waiting for Federal Motor Vehicle Safety Standards certification and had three more months downtime due to a battery pack issue.

Pasha Distribution was also engaged in the pilot project to test the performance of electric trucks in moving cars from their main lot to other destinations. These trucks were assigned shorter routes and hauled fewer cars than their diesel counterparts.

Another pilot participant, Estes Express, experienced no range limitations on their shorter routes. However, they indicated that electric drayage trucks were only a viable replacement for diesel trucks if the electric alternative could operate 350-400 miles of range. Like Estes Express, Sea-Logix found the electric drayage trucks were a good diesel replacement for their short route operations with single daily shifts.

The public power provider engaged in the pilot, LADWP, was concerned with charging time and infrastructure deployment. Fully integrating electric trucks into drayage fleet operations from the utility's perspective would require a charging infrastructure network comparable to that for fueling diesel and other internal combustion engine vehicles.

Electric trucks usually have higher GVWR than their diesel counterparts. Fleets need to pay attention to possible payload limitations that could impact usage. Whether payload will be a concern depends on the fleet and their cargo. Most fleets in this pilot project did not have an issue with payload. However, as previously noted they did experience other issue that are highlighted in the table below. As ZE technology evolves, fleets should continue testing electric trucks for drayage applications with similar use cases to understand range constraints and charging requirements. This will enable fleets to determine the appropriate and optimal route distance and number of daily shifts.

Fleet Transition Consideration	*Operational Difficulties*	*Range Anxiety*	*Charging and infrastructure Issues*	*Payload Issues*	*Mechanical Issues*
TTSI	Need 9-10 hours in operation daily but only worked 5-7 hours	Ran less than 30 miles one-way	Not a concern. Took 90-min opportunity charge between shifts.	No issue. Operation weight 36,000-40,000 lbs was lower than GVWR.	Telematics system issue; battery pack issue; FMVSS certification issue
GSC	Had issue hauling loads up inclines or reach high speed on highway	No issues. Noticed range was affected using AC and heating	Need electrical upgrades to install additional chargers	EV hauled less payload due to battery weight	Loose wiring and was down for 4 days; diesel trucks had more downtime than EV
Gen Logistic	Towed back twice going uphill due to heavy load	50-60 miles with an ideal range of 100 miles	Slow charging speed; misleading specs of charging station	No, since no need to be scaled	Water pump failure; gear jumps to neutral
Sea-Logix	N/A	Used for trips with range of 110 miles; can't be used when driving needs are 500 miles daily	Slow charging speed; charge lock not working	No concerns	ECU overheating; air compressor issue
Golden State Logistics	N/A	N/A	Charger shortage; ran only one shift due to charging time	7,000-9,000 lbs heavier than diesels; had to be careful with payloads	ECU overheating; temperature sensor error; DC-DC converter issue; vehicle unable to start; water pump connector issue
Quik Pick Express	N/A	Range limits EVs' day-to-	Need electrical upgrade to	8,000 lbs heavier.	N/A

		day use. The current range was 110-125 miles but ideally should be 300 miles.	install more chargers. Charging time limits to daily single shift on local delivery	Used for light load or empty containers	
Pasha Distribution	N/A	Range limited performance. EVs were used for short routes only.	Didn't park where chargers were installed. Constructed another charging infrastructure close to the parking spot.	EV hauled less cars than diesel ones	N/A
Harris Ranch Beef Company	One-month waiting time for registration paperwork	Operation required 400-500 miles daily range while EV had ranges of 120 miles. Also there were limited opportunities to use them on local routes.	No concerns	No issue	50% downtime caused by issues with battery management system, coolant pump, battery, wheel sensor, and power steering hose
Werner Enterprises	N/A	N/A	Overnight charging pause	N/A	Systems control module (SCM) plates issue
Oak Harbor	N/A	Operated 80-90 miles daily and had no issues when A/C was on.	No issues	No concerns since they did not operate close to 80,000 lbs.	Transmission replacement; drive angles adjustment; ground fault; intermittent shift issues; loose wiring; powertrain control module (PCM) issue
NFI	Concerns on the availability and uptime of EVs.	The 140-mile regular round trip requirement was beyond EVs' range. EVs were used for local operations.	No issues	No concerns. Containers were limited by volume. Max weight was around 70,000 lbs.	Broken mounting bracket; ABS trailer warning light failure; SOC issues
Estes Express	N/A	EVs' range limited their deployment	No issues	N/A	Plate rivet; odometer issue; electrical issues caused

		on routes such as Pick-up & Delivery or linehaul operations			downtime; battery issues
Daylight	N/A	Added an additional battery pack to increase range since EV could barely complete the shortest 102-mile round trip.	AC charger was out of service twice.	No issue. The actual operation load was 8,000-35,000 lbs.	Drive stability warning light; A/C; battery pack replacement; transmission failure; damaged electrical box of motor
LADWP	Extensive downtime due to mechanical issues and FMVSS certification.	Range limitation	Had difficulties on in site evaluation, construction, and installation. Charging duration longer than expected. Had only one charger making it difficult to manage operation.	Payload limitation	Electric control module issues