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

Attachment 2:
Vehicle and Infrastructure Product Readiness

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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Medium- and Heavy-Duty Vehicle Ecosystem

Ava Community Energy (Ava) previously established a baseline of the medium-and heavy-duty (MDHD) goods movement vehicles registered throughout its service territory. Table 1 demonstrates the quantity of vehicles by class and vocation. The analysis completed in this report provides a summary of the vehicles currently capable of transitioning to zero-emission (ZE) options as well as evaluates policy drivers that will impact the vehicle ecosystem over time.

Table 1. Ava Service Area Vehicle Inventory by Vocation

Vocation	Regional Truck Class 3-6	Regional Truck Class 7-8	Van Cargo Class 3-6	Step Van Class 3-6	Step Van Class 7-8	Terminal Tractor Class 7-8	Drayage Class 7-8	Long Haul Truck Class 7-8
AGRICULTURE/FARM	38	31	1	3		2	1	5
BEVERAGE PROCESSING	78	106		1			1	10
BUS TRANSPORTATION		17				1	1	10
CONSTRUCTION	598	455	10	1			18	156
DEALER	81	47	2	1			1	7
EMERGENCY VEHICLES	23	3	3	1		8		
FOOD DISTRIBUTION	743	759	27	40			12	306
FORESTRY/LUMBER PRODUCTS	57	48	1			4	7	30
GENERAL FREIGHT	765	1776	15	51	1		885	1925
GOVERNMENT/MISC	69	141	5	4			6	8
HAZARDOUS MATERIALS	2	7						
INDIVIDUAL	151	71				2	1	9
LANDSCAPING/HORTICULTURE	136	42	3	13			8	20
LEASE/FINANCE	1	1				5	37	174
LEASE/RENTAL	1231	382	19	31		3	31	74
MANUFACTURING	3							
MISCELLANEOUS	26	3		1				2
MINING/QUARRING	146	84	1				2	15
MOVING AND STORAGE	37	24		1			4	16
PETROLEUM	7							
PETROLEUM/HAZARDOUS	5	1						1
ROAD/HIGHWAY	5	1				1		
SANITATION/HAZARDOUS	87	145	2	7		10	28	60
SANITATION/REFUSE	1375	316	68	751			170	301
SERVICES	16	34					8	23
SPECIALIZED/HEAVY HAULING	276	128	24	41			43	86
UNCLASSIFIED	39	133	4	1			1	9
UTILITY SERVICES		3				14		3
WHOLESALE/RETAIL	1480	510	41	43			72	130
Total Service Area	7475	5268	226	991	1	50	1337	3380

Introduction to the Zero Emission Technology Inventory (ZETI)

The Zero-Emission Technology Inventory (ZETI) tool is an interactive online resource, managed by CALSTART, to establish a current and shared knowledge base for worldwide commercially available offerings of ZE MDHDs. The tool aims to provide fleets and public agencies with comprehensive information including regions where commercially available[1] ZE MDHD models are currently available for purchase and/or lease, and the timeline over which additional models are expected to become available according to original equipment manufacturers (OEM) plans. An evaluation of model trends based on ZETI data can be found on ZETI Analytics.[2]

ZETI Vehicle Assessment

Within the scope of the Ava ZE Goods Movement Blueprint, ZETI has been utilized to identify ZE MDHD models available today, and near future, that could meet the vocational needs of goods movement vehicles registered in Ava's service territory (Task 2, Baseline Inventory). While ZETI is an evolving data source, this analysis found that vehicles are available for fleets and independent owner operators. Table 2 provides an alignment between the Ava vehicle inventory and the zero-emission vehicles in ZETI.

Table 2. Vehicles by Type within Ava Service Area

	Quantity
Cargo Van (Class 3-6)	226
Medium-Duty Step Van (Class 3-6)	992
Medium-Duty Truck (Class 3-6)	7,475
Heavy-Duty Truck (Class 7-8)	10,035
Total	18,728

The following tables list ZE MDHDs available in the market between now and 2024. The tables are separated by vehicle type/use case. Highlighted vehicle models have voucher reimbursements available through the California Hybrid and Zero-Emission Truck and Bus Incentive Project (HVIP). Note: the ZETI database is based on the best available data and may not reflect the most recent model capabilities.

Table 3. ZE Medium-Duty Make/Models: Cargo Vans and Step Vans

Cargo van (Class 2b-3)
Arrival Van
Canoo MPDV1
Canoo MPDV2
Envirotech (EVTV) 2021 EVTV Logistics Van
Envirotech (EVTV) All-Electric Cutaway & Chassis
Ford E-Transit
GM EV600
Greenpower EV Star Cargo, Cargo Plus
Lightning eMotors Transit cargo van

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[1] Commercial availability is defined as availability for immediate production based on placed orders.
[2] https://globaldrivetozero.org/tools/zeti-analytics/

Cargo van (Class 2b-3)
Sea Electric Ford Transit Cargo Van (Class 2b, 3)
Sea Electric Mercedes Sprinter Cargo Van (Class 2b, 3)

Table 4. ZE Medium-Duty Make/Models: Step Van (Class 3-6)

Medium-Duty Step Van (Class 3-6)
Freightliner MT50e
Lightning eMotors Ford F-59 Step Van
Motiv E-450 Step Van
Motiv F-59 Step Van
Rivian Rivian EDV
SEA Electric FCCC Step Van (Class 3-7)
SEA Electric Ford E-450 stripped chassis
SEA Electric Ford F-59 Class 5-6
Unique Electric Solutions FCCC MT-55 EV
Unique Electric Solutions Ford F-59 EV
Unique Electric Solutions International 1652 EV
US Hybrid eCargo
XOS Step Van

Table 5. ZE Medium-Duty Make/Models: Trucks

Medium-Duty Truck (Class 3-6)	
BYD 5F	SEA Electric Chevrolet 3500, 4500, 5500, 6500XD
BYD 6F	SEA Electric FCCC MT50e
BYD T7	SEA Electric Ford E-350, F-449, F-450, F-53
Envirotech (EVTV) Urban Electric Truck	SEA Electric SEA Electric Ford F-550, F-650, F-750
Freightliner eM2 106 - Class 6	SEA Electric Ford Transit Chassis Cab (Class 2b,3)
Greenpower EV Star CC	SEA Electric Freightliner M2 103, 104
International eMV Class 6	SEA Electric GMC 4500 cutaway
Kenworth K270E	SEA Electric Hino 155, 195, 238, 258, 268,338
Kenworth K370E	SEA Electric International Durastar 4300
Lightning eMotors Chevrolet 6500XD	SEA Electric Isuzu FSR, FTR, NPR, NQR, NRR, REACH
Lightning eMotors E-450 Box Truck	SEA Electric Mercedes Sprinter 4500 Chassis Cab
Lion Lion6	SEA Electric Peterbilt 220, 325, 330, 337, 348
Motiv E-450 Box Truck	Unique Electric Solutions Ford E-450 MD Truck
Motiv E-450 Work Truck	Workhorse C1000
Peterbilt 220EV Class 6	Zeus Electric Chassis Z-19
Peterbilt 220EV Class 7	Zeus Electric Chassis Z-22
Phoenix Motorcars ZEUS 500 Truck	Zeus Electric Chassis Z-26

Table 6. ZE Heavy-Duty Make/Models: Trucks

Heavy-Duty Truck (Class 7-8)	
BYD 8TT	Roush Roush Ford F-750
Freightliner eCascadia	SEA Electric Autocar ACMD Class 7
Freightliner eM2 106 - Class 7	SEA Electric Autocar ACMD Class 8
Hyundai HDC-6 NEPTUNE	SEA Electric Freightliner Cascadia
Hyundai XCient	SEA Electric Freightliner M2 105
Hyzon FCET 6	SEA Electric Freightliner M2 106
Hyzon FCET 8	SEA Electric Hino GH EV
Kenworth T680	SEA Electric Kenworth T370
Kenworth T680E	SEA Electric Peterbilt 365
Lion Lion8	SEA Electric Peterbilt 367
Mercedes-Benz eActros	SEA Electric Peterbilt 520
Nikola Tre BEV	SEA Electric Peterbilt 567
Peterbilt 520EV Class 6	Tesla Semi
Peterbilt 520EV Class 7	Toyota Beta
Peterbilt 579EV	Volvo VNR Electric

Tables 2-6 reflect robust ZE MDHD availability that could meet the needs of vehicles registered in Ava's service area. However, determining vehicle readiness based solely on duty cycle is more complex. Gradeability, differing payloads, and varying speeds and distances will impact day-to-day use of ZE MDHDs. To provide a clearer view of the MDHDs that would be ready to transition to ZE alternatives, the analyses below evaluated how to reconcile the current market availability of ZE MDHDs with the operational assumptions that can be made by vocation for the MDHDs registered in Ava's service area.

Figure 1 represents the maximums of estimated ranges in ZE MDHDs by category available in North America over time. The maximum estimated range is portrayed in the figure, therefore not reflecting the variety of ranges within each vehicle category. This chart is best used as a general informant of range trends for ZE MDHDs from 2019-2022. Additionally, it's important to note that information collected from the ZETI tool is based on manufacturer provided specifications and may not reflect actual on-road conditions.
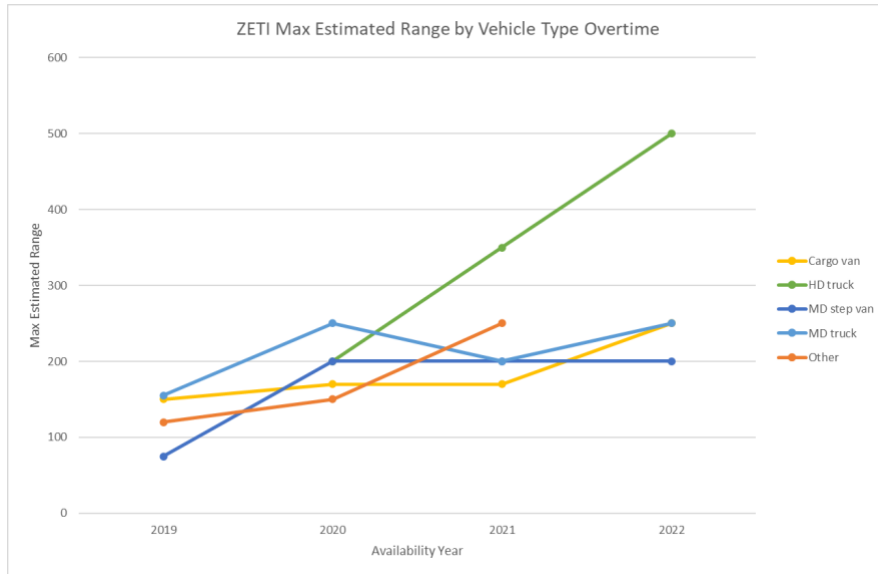
Figure 1. ZETI Max Estimated Range

To complement range estimates that indicate vehicle use the National Renewable Energy Laboratory's Fleet DNA: Commercial Fleet Vehicle Operating Data has been leveraged. NREL Fleet DNA[3] data represents baseline range requirements for vehicles of similar category and weight class as those in Ava's service area. Figure 2 below shows average and maximum daily mileage by vehicle type and weight class.
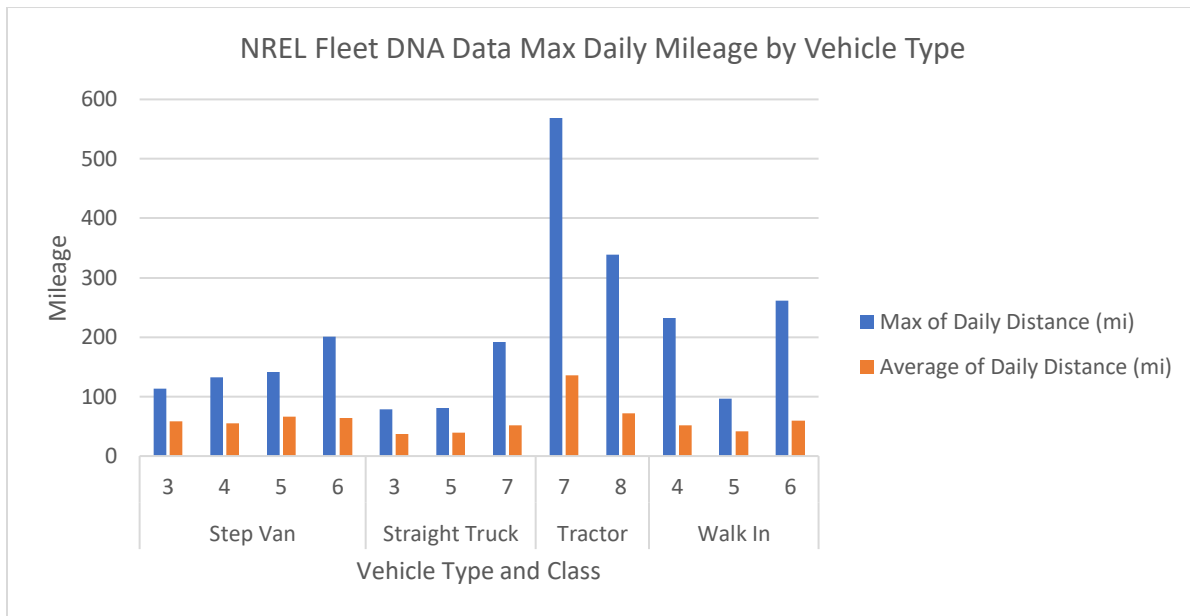

Figure 2. NREL Fleet DNA Data Max Daily Mileage by Vehicle Type

By combining the baseline NREL average and max expected ranges by vocation, and the ZETI average and max ranges listed in commercially available vehicles, Table 7 demonstrates how ZE MDHDs can meet the

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[3] https://www.nrel.gov/transportation/fleettest-fleet-dna.html

needs of these use cases. The Ava vehicle count represents the number of vehicles registered within the Ava customer area that match the NREL vehicle categories and vocations.

Table 7. EV Availability by Class and Vocation[4]

Vehicle Category	Vocation	Ava Area Vehicles	Baseline NREL Daily Mileage		2019-2024 ZETI EV Ranges	
			Average	Max	Average	Max
Regional Truck Class 3	Food Delivery	743	37	79	175	200
Regional Truck Class 5	Food Delivery	743	40	81	178	200
Regional Truck Class 7	Linen Delivery	316	62	91	200	250
	Parcel Delivery	510	28	85	200	250
	Warehouse Delivery	1776	93	191	200	250
Van Cargo Class 3	Parcel Delivery	84	58	113	180	230
Van Cargo Class 4	Parcel Delivery	84	54	232	190	190
Van Cargo Class 5	Linen Delivery	729	66	141	200	200
	Parcel Delivery	109	42	97	200	200
Van Cargo Class 6	Linen Delivery	819	69	262	172	200
	Parcel Delivery	84	35	88	172	200
Terminal Tractor Class 8	Beverage Delivery	11	10	10	19	24
Long Haul Truck Class 7	Beverage Delivery	11	29	48	193	250
	Food Delivery	306	164	568	193	250
	Local Delivery	1924	127	249	193	250
Long Haul Truck Class 8	Beverage Delivery	11	71	339	243	500

Table 7 also compares average and max ranges for each vehicle category and weight class from baseline diesel vehicles. NREL Fleet DNA provided a baseline for daily mileage of over 2000 vehicles of their respective categories and weight classes. Data spanning 2019-2024 found the average and max ranges of available ZE MDHDs using data from the ZETI database. The categories and weight class from NREL Fleet DNA and ZETI were matched to the categories from Ava's service area wide vehicle registration. Conditional formatting was used to highlight ZE MDHD range estimates that meet diesel baseline range requirements (in green). Warmer colors symbolize if the ZE MDHD range is less than the max baseline range. Matching average and max range represent market availability for finding ZE MDHDs that are a good fit for replacement of internal combustion trucks and vans while meeting similar operational range requirements. As shown above there is market availability to fit the average range of each of the baseline diesel vehicle categories depicted in NREL Fleet DNA. However, some categories including class 4 and 6 cargo vans, and long-haul class 8 trucks do not have matching max range availability (see ZETI column in yellow).

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[4] Note: Table 7 compares Ava, ZETI, and NREL data. Between databases there are vehicle categories that do not align or are missing from another databases. For example, NREL Fleet DNA data provides "cargo" van data but not "step" van specific data which is included on other tables.

Table 8 provides the top 3 vocations for each vehicle category for the Ava service area. These vocations are important to note when determining range requirements for ZE MDHD replacement. The vocations of the majority of the Ava service area mostly match with those sampled in the NREL diesel baseline data.

Table 8. Ava Vehicle inventory: Top 3 Vocations by Vehicle Class

Vehicle Category	Top 3 Vocations	Vehicle Count
Regional Truck Class 3-6	Wholesale/Retail	1480
	Services	1375
	Manufacturing	777
Regional Truck Class 7-8	General Freight	1776
	Food Processing & Distribution	759
	Wholesale/Retail	510
Van Cargo Class 3-6	Services	68
	Wholesale/Retail	41
	Food Processing & Distribution	27
Terminal Tractor Class 7-8	Wholesale/Retail	14
	Services	10
	Food Processing & Distribution	8
Long Haul Truck Class 7-8	General Freight	1924
	Food Processing & Distribution	306
	Services	301
Drayage Class 7-8	General Freight	883
	Services	170
	Wholesale/Retail	72

As part of the Advanced Clean Trucks (ACT) regulation, the California Air Resources Board (CARB) recorded data through a one-time reporting requirement from large entity fleets. The fleets required to report this data were defined by meeting criteria such as operating with gross annual revenues greater than $50 million, dispatching more than 50 or more vehicles greater than 8,500 lbs GVWR.

More granular data was shared with CARB by Air District and vehicle type.

Table 9 demonstrates how available ZE MDHDs in the ZETI database can replace vehicles recorded within the Bay Area Air Quality Management District (BAAQMD) based on the ACT collected data. Except for the City of Tracy in San Joaquin County, Ava's entire service area is within BAAQMD's boundaries. For the purposes of this analysis, it is assumed that the vehicle operational characteristics will be similar by vehicle types regardless of fleet size.

Table 9. ACT Large Entity Reporting Data

	ACT	100 mi	150 mi	200 mi	300 mi	300+ mi	ZETI	
Van Cargo	Van-Cargo						Average	Max
	Class 2b-3	89%	6%	2%	2%	1%	154.1	230
	Class 4-6	100%					190	190
Long-Haul/Drayage	Tractor Day Cab						Average	Max
	Class 4-6	68%	32%				90	90
	Class 7-8	41%	24%	12%	12%	11%	176.9	500
Step Van	Van-Step						Average	Max
	Class 2b-3	100%					200	200
	Class 4-6	98%	2%				166.3	200
Regional Truck	Box Dry Van						Average	Max
	Class 2b-3	91%	7%	2%			155	200
	Class 4-6	77%	17%	4%	1%	1%	174.0	250
	Class 7-8	69%	20%	5%	3%	3%	186.2	250
Terminal Tractor	Yard Tractor						Average	Max
	Class 7-8	100%					15.2	24

From this mileage readiness analysis between the ACT Bay Area data and ZETI data, the percentages of ACT Bay Area vehicles for each category based on range availability can be compared to the number of vehicles in similar categories within the Ava service area. The table below shows the total number of vehicles for each category for fleets that matched within Ava's service area. The "# ready" column for Ava area show approximately how many vehicles are ready to be replaced with a ZEV vehicle by applying the same percentages from the Bay Area ACT data to the Ava service area database.

Table 10. Vehicle Inventory Readiness per ACT Bay Area Data in Ava Service Area

	# Ready	Total #	ACT		ACT	ACT
Van Cargo			Van-Cargo	% Ready	# Ready	Total #
	226	226	Class 4-6	100%	35	35
Long-Haul/Drayage			Tractor Day Cab			
	3074	4717	Class 7-8	65%	2330	3575
Step Van			Van-Step			
	991	991	Class 4-6	100%	340	340
Regional Truck			Box Dry Van			
	7073	7475	Class 4-6	**95%**	**2428**	**2566**
	4666	5268	Class 7-8	89%	318	359
Terminal Truck			Yard Tractor			
	50	50	Class 7-8	100%[5]	92	92

For example, 95% of Class 4-6 Box Dry Vans (e.g., Class 3-6) in Ava's Alameda County service area have a ZE MDHD with matching maximum range according to the ZETI database.

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[5] Assuming 30 miles per day is not exceeded

Market Readiness 2030-2040: Projections

Accurately depicting where the emerging ZE MDHD market will be in 5 years is difficult, much less extrapolating current market trends to 2040. CALSTART continues to analyze market trends relevant to this segment. The recently developed Drive to Zero Market Projection Tool[6] estimates the adoption rate of on-road ZE MDHDs across countries, particularly focusing on those that have joined Drive to Zero's Global Memorandum of Understanding for trucks and buses.

The figure below demonstrates global pathways by vehicle segment. This assessment is aligned with CALSTART's beachhead strategy that dictates fleet readiness by vehicle type and use case. In the beachhead strategy, applications of ZE MDHDs are listed in order by ease of transition. Like buses and passenger shuttles, urban/regional delivery, cargo vans and short haul/regional use cases can have predictable and repetitive routes, may travel shorter distances, and have duty cycle attributes that would allow for depot charging. Alternatively, long-haul applications are currently more difficult to meet and the technology is nascent.
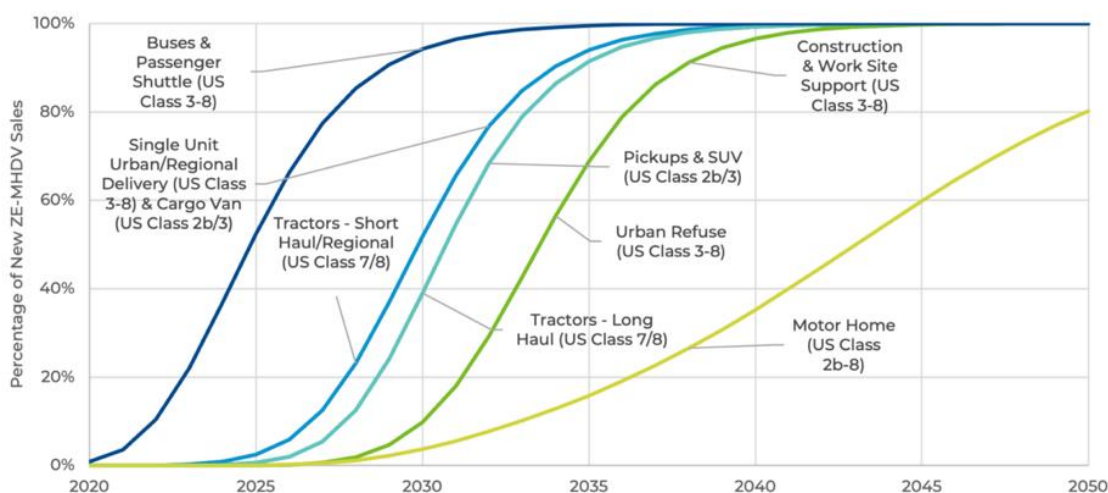

Figure 3. Global Pathways by Vehicle Segment

Ava's role as the default Load Serving Entity (e.g., public power provider) is particularly critical to the transition to ZE MDHDs as fleets and/or independent owner operators need assurance that reliable, convenient, and affordable charging infrastructure will be available to ensure business continuity. The importance of infrastructure availability, whether public or private, is factored into the Drive to Zero Projection tool. The methodology notes that fleets are willing to purchase a technology at 70% availability even when refueling availability is 30-40% as compared to diesel fueling station availability.

The goods movement industry is currently preparing for an injection of federal funding for charging infrastructure, while multiple states implement clean truck regulations, and California prepares to release an additional $873 million in purchase incentives for commercial vehicles and infrastructure (HVIP and EnergIIZE). Despite these regulatory frameworks and financing resources, full-scale adoption is decades away and the ability to provide technical assistance in the transition will be just as relevant as ZE vehicle market readiness. Ava's ZE MHD Goods Movement Blueprint will consider this perspective and fleets'

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[6] https://globaldrivetozero.org/publication/global-sales-targets-zemhdvs/

willingness to purchase ZE trucks and vans in the coming years. Among Ava's Blueprint priorities is identifying where strategic deployment of infrastructure solutions can be accelerated to support the needs of the MDHD goods movement ecosystem operating in their service area.

The [Zeroing in on Zero Emission Trucks (ZETs)](#) report, developed by CALSTART with CARB funding, provides a national outlook on ZET market trends. CALSTART found that medium-duty trucks, cargo vans, and step vans were deployed five years before the deployment of any other ZET segment. Together these segments also comprised 75% of all truck deployments in 2021 across 22 states, though 50%+ of these vehicles were in California, representing 61% of all ZET deployment). Additionally, in 2021 13% (258) of all HVIP vouchers were in the 9 County Bay Area (e.g., BAAQMD), the second highest regional uptake in the state.

Looking beyond what is currently available in the market the ACT regulation outlines Class 2b-8 ZET sales requirements for manufacturers from 2024 to 2035. Between 2024 and 2035, the ACT Regulation is expected to drive adoption of 765,000 ZETs statewide with MD vehicles representing most of that uptake. By 2035 the ACT regulation will require 70% of MD trucks sales to be ZETs.

ACT Regulation California ZET Sales Targets
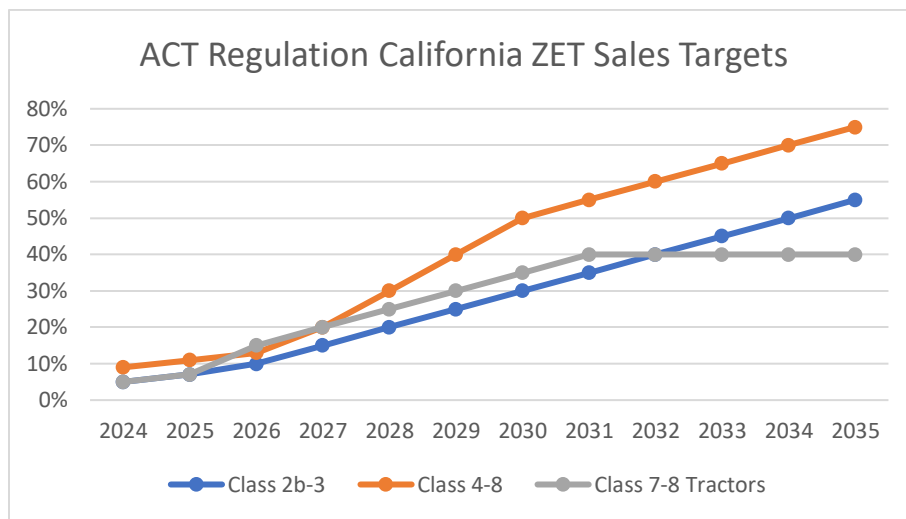
Most goods movement vehicles registered in Ava's service area are MD Class 3-6 with a focus on vocations related to wholesale/retail and other delivery services (3,758 vehicles or 20% of the 18,728 total trucks within Ava's service area).

By 2035 the ACT regulation will also require 40% of Class 7-8 tractor sales to be ZETs by 2035. 25% of the total Class 7-8 vehicles registered in Ava's service area (4,717 vehicles) will need to meet this requirement, most of which are drayage trucks.

Assuming this segment typically has a daily range demand of 100-150 miles, deploying publicly available fast charging depots strategically sited along freight corridors and/or near where drivers are doing business (if they are not able to charge overnight at a depot) will meet their operational demands.