COLORADO
Department of Transportation

Appendix A.

Transit ZEV Manufacturer Overview & Case Studies for ZEV Ready Transit Agencies and Fleets

Transit ZEV Manufacturer Overview

ZEV Manufacturer	Company (c) and Manufacturing (m) Location	Product Type	Production Schedule	In use by Colorado Transit Agency?	Annual Delivery Volume
APS Systems	Oxnard, CA	Conversion to Battery Operation or mix of Battery and Alternative Fuels	No information available	No	Data not available
AVASS Group	C: Melbourne, Australia M: Peru	BEB manufacturing Conversion to BEB	No information available	No	Data not available
Build Your Dreams (BYD)	C: Shenzhen, China M: Lancaster, CA	BEB manufacturing	Consistent monthly manufacturing numbers	RTD[4]	2019: 451,246
Green Power Motor Company	C: Vancouver, Canada M: Porterville, CA	BEB, electric traction motors, and battery management systems	No information available	No	Midway through 2020: 62 EV deliveries
GILLIG	C&M: Livermore, CA	Hybrid-electric, BEB	No information available	Town of Vail	Data not available
Lightning Motors	C&M: Loveland, CO	Conversion to BEB	No information available	City of Boulder (Via)	Data not available
New Flyer Industries	M: Alabama, Minnesota, New York, Winnipeg	Battery and Fuel Cell	No information available	RFTA	2019: 3,931
Novabus	C: Quebec, CA M: Plattsburgh, NY	BEB manufacturing	No information available	No	Data not available
Proterra	C: Silicon Valley/ Burlingame, CA M: Los Angeles/City of Industry CA, Greenville, SC	BEB Manufacturing	No information available	Town of Avon, ECO Transit,Summit Stage, Town of Breckenridge	Data not available
Van Hool	C: Belgium M: Morristown, Tennessee	Fuel Cell	No information available	No	Data not available
ENC/El Dorado	C&M: Riverside, CA	Fuel Cell	No information available	No	Data not available

Characteristics Of ZEV Ready Transit Agencies & Fleets

Transit agencies/fleets that have had successful ZEV transitions have several commonalities as summarized below.

Conduct a fleet-wide assessment to develop short- and long-term ZEV transition goals

- Plan for incremental deployment/demonstration projects to verify how well different ZEV options meet the range of fleet needs and to refine ZEV charging and maintenance schedules
- Identify representative routes to model energy and vehicle range requirements
- Evaluate impacts of unique geographic and service characteristics to identify necessary strategies to prevent service quality impacts

Leverage long-term planning goals to maximize use of available funding

- Long-term utility infrastructure sizing (make-ready investments such as upsizing transformer pads or laying additional conduit) strategies add minor additional costs to earlier deployments but will reduce overall long-term costs

Develop phased plans to upgrade/retrofit maintenance facilities and bus depots

- Assess installation, space and power requirements for short- and long-term fueling infrastructure needs
- Ensure clear communication with new vendors to reduce costs associated with incremental retrofitting
- Evaluate and plan for land purchases to house current and future transit fleets
- (BEB Infrastructure) Upgrade/retrofit bus yards to accommodate additional equipment and evaluate potential to use gantries for overhead depot charging or cord management
- (FCEB Infrastructure) Evaluate opportunities to retrofit existing fuel storage and CNG fueling stations for compressed hydrogen fuel

Involve diverse stakeholders early in the development and transition process

- **Internal Stakeholders:** Operations and planning, maintenance and engineering, training, facilities, finance procurement, IT, sustainability manager, contract operator, board or executive leadership, public information officers
- **External Stakeholders:** governmental agencies, electric utilities, labor unions, environmental justice, surrounding communities and other interest groups

Consult with electric utilities to plan for electrical infrastructure needs, review rate schedules and collaborate to develop mutually beneficial incentives or pilot programs

- Review reliability reports to understand the frequency and types of outages that have occurred and develop resiliency plans with the utility

Provide proactive training for operations and maintenance staff

- Consult with labor unions to ensure needed accommodations are implemented in deployment plan

Chicago Transit Authority (CTA), Chicago, IL

The Chicago Transit Authority (CTA) deployed two electric buses in 2014. This was considered one of the first major tests of electric bus technology in cold climates. There have not been any reported issues with extreme temperatures and the vehicles have delivered a total estimated savings of $24,000/year in fuel and $30,000 in saved maintenance costs. In 2018, purchased 20 new, all-electric buses, extending their commitment to fleet modernization and support of green initiatives to address the impacts of climate change.[2] CTA is planning to move forward with full fleet electrification by 2040.[3]

Duluth Transportation Authority, Duluth, MN

The Duluth Transportation Authority (DTA) was awarded $6.3 million under the FY 2013-2014 Low or No Vehicle Deployment Program for the purchase of six fast charging electric buses, two charging stations and a maintenance facility charger.[4] The cold climate and unique topography of Duluth also allowed for electric buses to be assessed in these specific conditions. Early reviews of the buses show that the battery ranges performed better in the summer than winter months. Charges in the winter season "struggled to reach eight hours and some battery charges ran as short as five and a half hours." When the buses were in development, fleet assessments demonstrated that cabin heating systems would draw too much energy from the battery during the winter. The manufacturer was able to address this issue by adding a supplementary fuel-powered heating source. There were also recorded braking issues with the electric buses, but these have also been addressed. DTA has recently ordered additional diesel buses to fill service gaps that arose from electric buses in need of repairs and overlapping charging times.[5]

The Twin Rivers Unified School District Department, Twin Rivers, CA

In 2017, the Twin Rivers Unified School District Department in California was one of the first school districts in the country to transition to electric school buses. In the initial deployment of the electric fleet, there were several infrastructural issues that included a delay in getting power to the site, blown chargers, and batteries would sometimes fail to sync. These issues delayed early deployment, however, have all been resolved. Currently, the electric fleet has produced an almost 80 percent fuel cost savings. The district also reported a total annual savings of $15,000 on energy and maintenance costs.[6]

1 Guidebook for Deploying Zero-Emission Transit Buses, 2020

2 https://www.transitchicago.com/cta-expands-electric-bus-fleet/

3 https://uspirg.org/sites/pirg/files/reports/ElectricBusesInAmerica/US_Electric_bus_scrn.pdf

4 https://www.transit.dot.gov/research-innovation/fiscal-year-2013-14-low-or-no-emission-vehicle-deployment-program-project

5 https://www.duluthnewstribune.com/business/transportation/3004653-Status-update-on-electric-buses-in-Duluth-Its-complicated

Appendix B.

Service & Maintenance Sector Readiness

Service & Maintenance Sector Readiness

It is important to note that OEMs, on occasion may work with specific component manufacturers (e.g., propulsion system, HVAC, doors, ramps, etc.) to supplement training activities, particularly in subject areas where ZEV operation varies significantly from operation and maintenance of the existing fleet.

Training Topics and Recommended Training Hours from ZEV Bus OEM[7]

- BEB Orientation = 4-8 hours
- Operator Training = 8-16 hours
- Maintenance Training = 32-48 hours
- Depot Charger maintenance Training = 16-32 hours

Proterra Case Study: Maintenance & Inspection Process

Proterra has established a standardized maintenance schedule for their zero emission vehicles. This includes routine daily service performed during fueling operations conducted by the transit agency.

Proterra vehicles are designed to ensure disassembly, reassembly, and servicing/maintenance using tools and equipment that are available as standard commercial items. However, additional system testing equipment (e.g., test ports) is often required to check air intake, exhaust, hydraulic, pneumatic, charge-air, and motor cooling systems on ZEVs. Special tools and pricing information is typically provided and submitted as a supplemental documentation to the pricing schedule. Transit agencies should factor these additional costs into their ZEV Fleet Transition Planning and feasibility analyses.

Best Practices for Employee Training Programs

Proterra Case Study: Staff Training

Proterra provides a staff member who serves as a training instructor. The instructor remains at the agency's property for a time and duration mutually agree by the agency and the company. The Proterra instructor provides training courses and guidance related to proper operation and maintenance for agency staff. Manuals, presentations, and other training literature (physical and digital copies) are supplied to the transit agency at this time. As a part of the procurement of a vehicle and charger from Proterra, the following training toolkit is provided to the transit agency:

Operator Training

- 40 hours of operator training
- Utilization of "Train-the-Trainer" approach to enable customers to provide as much training as required for their operators
- 50/50 split between classroom and seat-time for the operators

[7] zhttps://www.cyride.com/Home/ShowDocument?id=9880
[8] https://wichitaks.granicus.com/MetaViewer.php?view_id=2&clip_id=3837&meta_id=222876

Bus Maintenance Training

- 36 hours of vehicle maintenance training
- Classroom and hands-on training

Bus Introduction Training

- 16 hours of general bus introduction training
- Meant for supervisors, managers, and procurement

Bus Maintenance Training

- 24 hours of charger maintenance training
- Classroom and hands-on training[9]

Battery Recycling

The International Energy Agency estimates that global efforts to transition fleets to ZEVs could mean that there are 200+ million ZEVs on the road by 2030. While the tailpipe emissions may be zero, there is a growing concern about the sustainability and availability of battery materials (e.g., lithium, nickel, cobalt, copper, etc.).

The market for batteries and sustainable battery recycling will expand as the ZEV market share expands. Several organizations and corporations view this as an opportunity to develop better manufacturing, recycling and disposal processes. A few of those efforts are highlighted below:

- The US Department of Energy's Recell Center brings together industry, academia and national laboratories to work to develop advanced recycling technologies with a vision of "using science-based strategies to remove the high-risk barriers to economical lithium-ion battery recycling [to] reduce waste, create jobs, encourage increased adoption of electric vehicles, and reduce the US reliance on foreign supplies of critical materials and mined metals used in battery materials."[10]

- The World Economic Forum's Global Battery Alliance is a public-private collaboration of organizations that view a circular battery value chain as a critical step toward meeting the Paris Agreement's 1.5C climate goal for the transportation and energy sectors. The Alliance has three impact programs: (1) a responsible and sustainable cobalt supply change, (2) a low-carbon economy program to accelerate deployment of batteries to realize the emission savings from electric vehicles and large-scale renewable energy grid storage, and (3) a circular economy program to address regulatory barriers to recycling batteries and create a blueprint for responsible end of life management of batteries.[11]

- Canadian-based Li-Cycle views "end-of-life batteries as a resource, not a waste" and recovers over 95 percent of critical materials from lithium-ion batteries via a process that substitutes leaching for the traditional smelting process.[12] As of 2020, Li-Cycle facilities had the capacity to process 10,000 tons of lithium-ion batteries per year and has plans to construct more facilities throughout North America.

- Redwood Materials is a Nevada-based company founded in 2017 to "make a material impact on sustainability" as the production of electric vehicles and batteries expands. Since 2017, Redwood has recycled more than a gigawatt-hours' worth of battery scrap material (enough to power 10,000 Tesla vehicles) and is looking to scale its operations to dramatically reduce mining of raw materials.[13]

In all, while there is no current solution to the ZEV battery conundrum, as ZEVs become increasingly commonplace, fleets such as transit fleets, can put pressure on the market to demand sustainable battery manufacturing processes.

[9] https://wichitaks.granicus.com/MetaViewer.php?view_id=2&clip_id=3837&meta_id=222876
[10] https://recellcenter.org/about/
[11] https://www.weforum.org/global-battery-alliance/action
[12] https://li-cycle.com/
[13] https://www.reuters.com/article/us-batteries-redwood-recycling/ex-tesla-exec-straubel-aims-to-build-worlds-top-battery-recycler-idUSKBN26S3IU

Appendix C.

Transit Fleet Data Sources

Transit Fleet Data Sources

There are several databases and resources that provide information critical to understanding the current composition of the larger Colorado transit fleet, including:

- Colorado Transit and Rail Awards Management System (COTRAMS) Capital Inventory records
- CDOT's Transit Asset Inventory Master Database
- 2018 Colorado DOT Transit Asset Management Group Plan
- FTA's National Transit Database Annual Vehicle Tables Plan

The National Transit Database (NTD) maintains information and statistics about transit agencies and providers who are recipients or beneficiaries of grants from the Federal Transit Agency (FTA) under Sections 5307 and 5311. CDOT works with its subrecipients to collect data about revenue vehicles, service (non-revenue) vehicles, equipment, facilities, and non-rail and rail fixed guideway infrastructure. CDOT maintains the Transit Asset Inventory Master Database and aggregates transit agency fleet and facility information in a format that is consistent with FTA reporting.

In 2016, the FTA mandated all chapter 53 recipients and subrecipients that own, operate, or manage capital assets used to provide public transportation to develop 'Transit Asset Management Plans' (TAM Plans) by October 2018. CDOT's Division of Transit and Rail (DTR) developed the *2018 Colorado DOT Transit Asset Management Group Plan*[14] (Group TAM Plan), which included capital assets from 53 Tier 2 public transportation providers in Colorado. **Table 1** provides an overview of the current inventory of NTD reporters across the state and summarizes what agencies each report to. Note that agencies are listed by their reporting name, not necessarily the publicly branded service name (e.g., Town of Winter Park is the reporter for The Lift).

Bustang, which began operating in 2015, is CDOT's interregional express bus service that connects urbanized areas across the State. Funded and managed by CDOT, Bustang is operated through a contract with a private transportation provider – Ace Express. Bustang currently provides express service along three lines: North Line (Denver to Fort Collins), West Line (Denver to Grand Junction), and the South Line (Denver to Colorado Springs). In 2018, CDOT initiated an intercity lifeline service, Bustang Outrider, to serve rural Colorado. Outrider routes are operated by third parties and currently connect Durango to Grand Junction, Alamosa to Pueblo, Gunnison to Denver, Lamar to Colorado Springs, and Denver to Craig with additional routes planned for 2021. Proposed routes include Sterling to Greeley/Denver, Trinidad to Pueblo and Telluride to Grand Junction. CDOT owns 24 diesel motor coach buses that operate on Bustang routes and eight diesel motor coach buses that operate on Outrider routes. Bustang and Outrider fleet information is currently not reported to NTD or included in the CDOT Transit Asset inventory.

[14] https://www.codot.gov/programs/transitandrail/plans-studies-reports/2018-TAMplan#:~:text=Transit%20asset%20management%20(TAM)%20is,of%20Good%20Repair%20(SGR).&text=FTA%20defines%20TAM%20policy%20as,all%20of%20its%20capital%20assets

Table 1: Transit Agency Reporting Summary - by TPR

	CDOT TAM Plan	2019 NTD Reporter	2020 Transit Asset Inventory	2019 SGR Inventory
Central Front Range				
Cañon City Golden Age Council, Inc (dba Fremont County Transit/Golden Age Shuttle)				
Cripple Creek, City of	Yes	Yes	Yes	Yes
Park County Senior Coalition	Yes	Yes		Yes
Teller Senior Coalition	Yes	Yes	Yes	Yes
Upper Arkansas Area Council of Governments	Yes	Yes	Yes	Yes
Eastern				
East Central Council of Governments	Yes	Yes	Yes	Yes
Northeastern Colorado Association of Local Governments (NECALG) (dba County Express and Prairie Express)	Yes	Yes	Yes	Yes
Grand Valley				
Mesa County Regional Transportation Planning Organization (dba Grand Valley Transit)	N/A	Yes	Yes	Yes
Greater Denver Area				
Black Hawk, City of (dba Black Hawk and Central City Tramway)	Yes	Yes	Yes	Yes
Broomfield, City and County of (dba Easy Ride)	Yes	Yes	Yes	Yes
Castle Rock Senior Center	Yes	Yes	Yes	Yes
Lakewood, City of (dba Lakewood Rides)	Yes	Yes	Yes	Yes
Littleton, City of (dba Omnibus)	Yes	Yes	Yes	Yes
Regional Transportation District (RTD)	N/A	Yes	Yes	Yes
Seniors' Resource Center, Inc. (SRC)	Yes	Yes	Yes	Yes
Via Mobility Services	Yes	Yes	Yes	Yes
Community Options, Inc.	N/A	N/A	Yes	Yes
Gunnison Valley				
Gunnison Valley Rural Transportation Authority	Yes	Yes	Yes	Yes
Montrose County Senior Citizens Transportation, Inc. (dba All Points Transit)	Yes	Yes	Yes	Yes
Mountain Express, The	Yes	Yes	Yes	Yes
Mountain Village, Town of	Yes	Yes	Yes	Yes
San Miguel Authority for Regional Transportation (dba SMART)	TBA	Yes	Yes	
San Miguel County	Yes		Yes	Yes
Telluride, Town of (dba Galloping Goose)	Yes	Yes	Yes	Yes
Intermountain				
Aspen, City of	Yes	Yes	Yes	Yes
Avon, Town of (dba Avon Transit)	Yes	Yes	Yes	Yes
Breckenridge, Town of (dba Free Ride)	Yes	Yes	Yes	Yes
Eagle County (dba ECO Transit)	Yes	Yes	Yes	Yes
Glenwood Springs, City of (dba Ride Glenwood Springs)	Yes	Yes	Yes	Yes
Lake County	Yes	Yes	Yes	
Mountain Valley Developmental Services	N/A	N/A	Yes	Yes
Roaring Fork Transportation Authority (RFTA)	Yes	Yes	Yes	Yes
Snowmass Village, Town of (dba Village Shuttle)	Yes	Yes	Yes	Yes
Summit County (dba Summit Stage)	Yes	Yes	Yes	Yes
Vail, Town of (dba Vail Transit)	TBA		Yes	Yes
North Front Range				
Berthoud Area Transportation Service (BATS)	Yes	Yes	Yes	Yes
Fort Collins, City of (dba Transfort)	N/A	Yes	Yes	Yes
Greeley, City of (dba Greeley Evans Transit - GET)	N/A	Yes	Yes	Yes
Loveland, City of (dba City of Loveland Transit - COLT)	Yes	Yes	Yes	Yes
Northwest				
Routt County Government	Yes	Yes	Yes	Yes
Steamboat Springs, City of (dba Steamboat Springs Transit - SST)	Yes	Yes	Yes	Yes
Winter Park, Town of (dba The Lift)	Yes	Yes	Yes	Yes
Pikes Peak Area				
Colorado Springs, City of (dba Mountain Metropolitan Transit – MMT/Metro Rides)	N/A	Yes	Yes	Yes
El Paso Fountain Valley Senior Citizens Program Inc.	Yes	Yes	Yes	Yes
Envida	Yes	Yes	Yes	Yes
Silver Key Senior Services	TBA	Yes	Yes	Yes
Pueblo Area				
Pueblo, City of (dba Pueblo Transit)	Yes	Yes	Yes	Yes
Senior Resource Development Agency, Pueblo, Inc. (Pueblo SRDA)	Yes	Yes	Yes	Yes

	CDOT TAM Plan	2019 NTD Reporter	2020 Transit Asset Inventory	2019 SGR Inventory
San Luis Valley				
Neighbor to Neighbor Volunteers (dba The Chaffee Shuttle)	Yes	Yes	Yes	Yes
South Central				
Huerfano/Las Animas Area Council of Governments (dba South Central Council of Governments - SCCOG)	Yes	Yes	Yes	Yes
Southeast				
Baca County Seniors Van	Yes	Yes	Yes	Yes
Bent County (dba Bent County Transit)	Yes	Yes	Yes	Yes
La Junta, City of	Yes	Yes	Yes	Yes
Prowers County (dba Prowers Area Transit – PAT)	Yes	Yes	Yes	Yes
Southwest				
Archuleta County (dba Mountain Express Transit)	Yes	Yes	Yes	Yes
Dolores County	Yes	Yes	Yes	Yes
Durango, City of (dba Durango Transit)	Yes	Yes	Yes	Yes
La Plata County Senior Services	Yes	Yes	Yes	Yes
Montezuma County Public Transportation	Yes	Yes	Yes	Yes
Southern Colorado Community Action Agency, Inc. (SoCoCaa)	Yes	Yes	Yes	Yes
Southern Ute Indian Tribe	N/A	Yes	N/A	
Upper Front Range				
Estes Park, Town of (dba Estes Transit)	Yes	Yes	Yes	Yes

There are 62 transit agencies included in the ZEV Roadmap Inventory. A total of 52 of the transit agencies are included in the CDOT TAM Plan, 59 are NTD reporters in some capacity, 61 are included in the CDOT Asset Inventory and 59 agencies were included in the Statewide Transit Plan State of Good Repair evaluation.

COLORADO
Department of Transportation

Appendix D.

NTD Vehicle Type Classifications

NTD Vehicle Type Classifications

Revenue vehicle type classifications, as defined by the FTA, and reflected in the NTD Database and the CDOT Transit Asset Inventory Master database include[15]:

Articulated Buses (AB) are extra-long (54 ft. to 60 ft.) buses with two connected passenger compartments. The rear body section is connected to the main body by a joint mechanism that allows the vehicles to bend when in operation for sharp turns and curves and yet have a continuous interior.

Automobile (AO) is a passenger car, up to and including, station wagons in size. Excludes minivans and anything larger.

Over-the-Road Bus (BR) is a bus characterized by an elevated passenger deck located over a baggage compartment.

Bus (BU) is a rubber-tired passenger vehicle powered by diesel, gasoline, battery or alternative fuel engines contained within the vehicle. Vehicles in this category do not include school buses or cutaways. This group does include minibuses such as a Sprinter.

Cutaway (CU) is a transit vehicle built on a van or truck chassis by a second stage manufacturer. The chassis is purchased by the body builder, a framework is built for the body, and then the body is finished for a complete vehicle. For example, a truck chassis may be used as the base for a small transit bus.

Light Rail Vehicle (LR) is a passenger rail car typically operating on fixed rails in shared or exclusive right-of-way, with low or high platform loading, and vehicle power typical drawn from overhead electric power lines.

Minivan (MV) is a light duty vehicle having a typical seating capacity of up to seven passengers plus a driver. A minivan is smaller, lower, and more streamlined than a full-sized van, but it is typically taller and has a higher floor than a passenger car. Minivans normally cannot accommodate standing passengers.

Commuter Rail Self-Propelled Passenger Car (RS) is a transit mode that uses an electric or diesel propelled railway that does not require a separate locomotive for propulsion for urban passenger train service consisting of local short distance travel between a central city and its adjacent suburbs.

Sports Utility Vehicle (SV) is a high-performance four-wheel drive car built on a truck chassis. It is a passenger vehicle, which combines the towing capacity of a pickup truck with the passenger-carrying space of a minivan or station wagon. Most SUVs are designed with a roughly square cross-section, an engine compartment, a combined passenger and cargo compartment, and no dedicated trunk. Most mid-size and full-size SUVs have three rows of seats with a cargo area directly behind the last row of seats. Compact SUVs and mini-SUVs may have five or fewer seats.

Trolleybus (TB) is a rubber-tired, electrically powered passenger vehicle operated on city streets drawing power from overhead lines.

[15] https://cms7.fta.dot.gov/sites/fta.dot.gov/files/docs/subdoc/186/2019-ntd-reduced-reporting-manual-v1-1_0.pdf

Aerial Tramway Vehicle (TR) is an unpowered passenger vehicle suspended from a system of aerial cables and propelled by separate cables attached to the vehicle suspension system. Engines or motors at a central location, not onboard the vehicle, power the cable system.

Van (VN) is an enclosed vehicle having a typical seating capacity of eight to 18 passengers and a driver. A van is typically taller and with a higher floor than a passenger car. Vans normally cannot accommodate standing passengers.

Similarly, NTD and CDOT categorize service vehicles into three vehicle types (two of which are used in Colorado):

Automobiles – passenger cars, up to and including station wagons in size. Excludes minivans and anything larger.

Trucks and Other Rubber-Tired Vehicles - A self-propelled, motor vehicle designed primarily for the transportation of property or special purpose equipment, typically a service vehicle. It may consist of a chassis and body; a chassis, cab and body; or it may be of integral construction so that the body and chassis form a single unit. This vehicle category also includes pickup trucks, vans, SUVs, and minivans.

Steel Wheel Vehicles (not included in the Colorado transit fleet) - In rail systems, vehicles with the specially designed cast or forged steel, essentially a cylindrical element that rolls on the rail, carries the weight, and provides guidance for rail vehicles. Steel wheel vehicles exclude vehicles that are equipped for both road (rubber tires) and rail.

COLORADO
Department of Transportation

Appendix E.

2018 Colorado Transit Fleet – Ownership Type By Vehicle Type

Table: 2018 Colorado Transit Fleet – Ownership Type by Vehicle Type

		Lease Purchase by a Public Agency	Lease Purchase by a Private Entity	Leased or Borrowed by a Public Agency	Leased or Borrowed by a Private Agency	Owned Outright by a Public Agency	Owned Outright by a Private Entity	True Lease by a Public Agency	True Lease by a Private Entity	Other
Revenue Vehicles	Articulated Bus					125				
	Automobile					23	66		1	
	Over-the-Road Bus	9			2	194	1			
	Bus	1			4	1189	27			
	Cutaway	1		4		699	113	1		3
	Light Rail Vehicle					172				
	Minivan					149	40	1		11
	Commuter Rail Self-Propelled Passenger Car					66				
	Sports Utility Vehicle					2				
	Trolleybus					1				
	Aerial Tramway					71				
	Van	1				68	46			1
Service Vehicles	Automobiles					48	1			
	Trucks and Other Rubber Tire Vehicles		5			58	7			

COLORADO
Department of Transportation

Appendix F.

Xcel EV Rate Schedule & Bill Example

Xcel EV Rate Schedule & Bill Example

Starting January 2020, Xcel Energy (one of Colorado's investor-owned utilities) began offering a Secondary Voltage Time of Use - Electric Vehicle Service (S-EV) rate to provide electric power and energy solely for commercial and industrial customer electric vehicle charging. The S-EV rate promotes off-peak charging and is designed to reflect that the cost of energy associated with charging EVs overnight is more a function of energy consumption (kWh) as compared to typical commercial and industrial energy demand (kW) that coincides with the peak system demand.

Table 1 compares the S-EV rate to the Secondary General (SG) rate the Regional Transportation District (RTD) was on prior to the addition of an S-EV specific rate schedule.

Table 1: 2018 Colorado Transit Fleet – Ownership Type by Vehicle Type[16]

	SG	S-EV
Service & Facilities Charge	$36.17	$36.17
Production Meter Charge	$9.30	-
Load Meter Charge	$9.30	-
Demand Charge:		
All kilowatts of Billing Demand, per kW		
Distribution Demand	$5.63	$5.63
Generation & Transmission Demand – Summer*	$14.02	
Generation & Transmission Demand – Winter*	$9.82	
Energy Charge:		
All kilowatt-hours used, per kWh	$0.00461	-
Summer*:		
On-Peak Energy Charge, per kWh[1]	-	$0.11400
Off-Peak Energy Charge, per kWh[2]	-	$0.03879
Winter*:		
On-Peak Energy Charge, per kWh[1]	-	$0.05971
Off-Peak Energy Charge, per kWh[2]	-	$0.01040
Critical Peak Energy Charge, per kWh[3]	-	$1.50

*The Summer Season extends from June 1 through September 30; the Winter Season is from October 1 through May 31.

[1] On-peak is defined as the time between noon and 8PM MT, on weekdays, except Holidays
[2] Off-peak is defined as all other hours of the year
[3] Critical Peak events last for a maximum of four hours between the hours of noon and 8PM for a maximum of 15 days per year. The Company has the ability to call a Critical Peak Pricing Period when system peaking conditions indicate the reserve load ratio may fall below 10 percent.

How do operating profiles match up with charging needs?

The following provides an illustrative example of how a transit agency's operating profile and charging strategy and rate schedule selection can result in significantly different utility bills. Each transit agency will have to assess vehicle performance on the selected routes and evaluate the range of utility rate schedules available to them. Consider the following hypothetical scenario in which a transit agency operates four electric buses that each:

- Travel 100 miles per day
- Consume 2 kWh per mile
- Operate on weekdays for an average of 22 days per month

[16] https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/PSCo_Electric_Entire_Tariff.pdf

For simplicity, assume high charger efficiency and that each bus requires 200 kWh of energy daily. Therefore, the entire EV fleet of four vehicles requires 800 kWh of energy to complete the required service each day, resulting in a monthly energy consumption of 17,600 kWh.

The transit agency can choose between the SG and S-EV rates summarized in **Table 2.**Now consider the agency would like to evaluate the same charging strategy under the two rate schedules:

- Baseline Scenario: the buses charge concurrently from 8PM to 10 PM at a power level of 100 kW each resulting in a peak demand of 400 kW. Total energy consumption is 17,600 kWh.

Table 2: Example Bill Impacts from Xcel Energy's SG and S-EV Rate Schedules

Baseline Scenario	SG	S-EV
Service & Facilities Charge	$36.17	$36.17
Production Meter Charge	$9.30	-
Load Meter Charge	$9.30	-
Demand Charge: All kilowatts of Billing Demand, per kW Distribution Demand Generation & Transmission Demand – Summer*	 $2,252 $5,608	 $2,252 -
Energy Charge: All kilowatt-hours used, per kWh Summer*: On-Peak Energy Charge, per kWh[1] Off-Peak Energy Charge, per kWh[2]	 $81.14	 - $682.70

[1] On-peak is defined as the time between noon and 8PM MT, on weekdays, except Holidays
[2] Off-peak is defined as all other hours of the year

The S-EV rate captures the lower electric system costs associated with energy demand and consumption in the off-peak hours. Under these conditions and available rate structures, the agency would benefit from selecting the S-EV rate. Typically, electric utility bills include a range of riders, in addition to the general rates, that impact the overall calculation of monthly bill. Riders are mechanisms by which utilities can recover variable costs between rate cases and vary greatly from utility to utility. This example provides a comparison of two general rate options and is intended to highlight the potential impacts of selecting or working with the local electric utility to develop a ZEV-friendly general rate.

Example Project: RTD MallRide Electrification & Demand Charges

In 2017, RTD purchased 36 BEBs to replace the MallRide compressed natural gas fleet. RTD was expecting to pay 73 cents per mile to operate its all-electric fleet. However, the agency had not modeled the impact of the demand charges on the existing rate schedule resulting in demand charges accounting for 80 percent of the electric bill. RTD subsequently evaluated alternative charging strategies (e.g., staggered charging) and worked with Xcel Energy to develop an EV Fleet Rate that incentivized off-peak charging.

Assuming the transit agency can utilize the S-EV rate that incentivizes off peak charging, consider the following charging strategies:

- Scenario 1: the buses charge concurrently from 9PM to 11 PM at a power level of 100 kW each resulting in a peak demand of 400 kW. Total energy consumption is 17,600 kWh.
- Scenario 2: the buses charge concurrently from 9PM to 1AM at a power level of 50 kW each resulting in a peak demand of 200 kW. Total energy consumption is 17,600 kWh.
- Scenario 3: the buses charge consecutively from 9PM to 5AM at a power level of 100 kW, resulting in a peak demand of 100 kW. Total energy consumption is 17,600 kWh.

Table 3 highlights the total estimated electricity charges associated with different charging strategies, all under the same S-EV rate schedule.

Table 3: Different Charging Strategies Under the S-EV Rate Structure

Baseline Scenario	Scenario 1	Scenario 2	Scenario 3
Service & Facilities Charge	$36.17	$36.17	$36.17
Demand Charge: All kilowatts of Billing Demand, per kW Distribution Demand	$2,252	$1,126	$563
Energy Charge: All kilowatt-hours used, per kWh Summer*: On-Peak Energy Charge, per kWh[1] Off-Peak Energy Charge, per kWh[2]	$682.70	$682.70	$682.70
TOTAL Estimated Utility Bill	$2,970.87	$1,844.87	$1,281.87
Equivalent Cost per Mile	$0.34	$0.21	$0.15

[1] On-peak is defined as the time between noon and 8PM MT, on weekdays, except Holidays
[2] Off-peak is defined as all other hours of the year

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Appendix G.

Colorado Transportation Electrification Plans (TEP)

Colorado Transportation Electrification Plans (TEP)

Consistent with SB 19-077, Public Service Company of Colorado (Xcel Energy) and Black Hills Energy filed TEPs with the CPUC. As the larger provider, the Xcel Energy TEP was heard before the PUC first with the intent that the larger policy decisions that emerged from the proceeding would subsequently be applied to the Black Hills TEP. The PUC decision on the Xcel TEP was issued in January 2021 and the Black Hills hearing and decision are anticipated by April 2021.

The policy decisions made by the PUC, while not applicable to the municipal and cooperative utilities, could serve as a template for implementing statewide policies guiding utility transportation electrification plans.

Xcel Energy Transportation Electrification Plan

The Xcel Energy Transportation Electrification Plan is a comprehensive plan to address transportation electrification across its entire service area with programs offered for passenger vehicles, as well as light-, medium-, and heavy- duty vehicles.

TEP elements that could apply to transit agencies include the Commercial, Research, Innovation and Partnership, and Low-Income plan portfolios.

Commercial Portfolio

Most transit agencies are commercial customers. As a large commercial customer in the Xcel service territory, RTD would be eligible to participate in select plan programs designed for commercial customers.
To ensure alignment with goals outlined in SB 19-077, the Xcel TEP, identifies commercial fleet strategies to support growth in transportation electrification. One of the commercial focus areas is centered on supporting fleet electrification directly by assisting with EV Supply Infrastructure and Optional Charging Equipment.

Xcel plans to work with customers to provide EV Supply Infrastructure to help remove costly barriers for transportation electrification transitions, as highlighted in Table 4. Customers will be given an option to procure their own charging equipment or obtain Level-2 charging equipment from Xcel. Xcel will offer EV supply infrastructure to support fleet operators with light-duty or medium-and heavy-duty vehicles who are transitioning their fleets to electric.

The provided equipment will be maintained by the company and customers will cover a monthly cost. To participate in this program customers must fill out an application and selection will be determined by the information defined in SB 19-077.

Table 4: Expecting Charging Station Ports Supported by Commercial Programs

Baseline Scenario	2021	2022	2023	Total
Fleet & Workplace Supply Infrastructure-Light-duty Vehicles	275	490	650	1,415
Fleet & Workplace Optional Charger Service—Light-duty Vehicles	125	225	300	650
Fleet & Workplace—Low Income	35	55	70	160

Charging Equipment

Customers will be provided with a list of specific charging equipment options that meet technical and safety standards, demonstrate interoperability, cyber security, and smart charging capabilities. Participating customers will then be asked to select from a list of prequalified charging equipment vendors. The prequalified options are offered at different price points to ensure flexibility for customer needs. Additionally, customers will also have the option of procuring their own charging equipment.

Rebates

- Level 2 Ports: $2,200
- Fast Charging for Medium-Duty and Heavy-Duty Vehicles for Low-Income Fleet and Workplace Program: $45,000
- It is expected that low-income rebates would be sufficient to cover level 2 costs and Direct Direct Current Fast Charge (DCFC) chargers

Rates

Optional Charger Service: Rate would be applicable to fleets and workplace. This service would equal the cost of providing, operating, maintaining, and recovery for Company-provided and installed charging equipment.

Research, Innovation and Partnership Portfolio

The Research, Innovation, and Partnership (RIP) Portfolio is aimed at "planning new and innovative ways to promote electrification of shared mobility, reduce DCFC charging costs through energy storage, offer workable charging optimization solutions for fleets and use AMI [advanced metering infrastructure] to detect the presence of electric vehicles (EV) to support grid planning efforts, and electrify school buses."

In SB-19-077, it is recommended that TEPs "stimulate innovation." In accordance with the goals set out by the Senate Bill, Xcel's RIP portfolio includes several items related to transit electrification innovation, including:

- Increasing access to electricity as a transportation fuel
- Minimizing system costs and increasing benefits of electric transportation
- Informing future TEP modifications

A little over $3 million has been set aside to cover the RIP portfolio outlined here. Over the course of three years, it is anticipated that TEP RIP items will cost $10 million.

Potential benefits that could come out of RIP projects include:

- Opportunities to identify more efficient grid integration with transportation electrification technologies
- Understanding of benefits that come out of more accessible transportation electrification
- Opportunities to reduce GHG and improving air quality
- Additional support for growth in innovation

A key element of the RIP portfolio is the Advisory Services program. Advisory Services were proposed for three major markets: residential, fleets, and community planning. For entities/organizations interested in electrifying their fleets Xcel will support customers in developing electrification readiness plans, aid in identifying infrastructure locations, and offer guidance on logistical details like rates and charging.

Additionally, specific planning support will be provided to assist communities in developing EV readiness plans, engaging residents, supporting fleets, and evaluating siting of public charging infrastructure. Xcel was directed to ensure the inclusion of less mature fleet markets, such as public transit and school buses and other medium- and heavy-duty vehicles.

Xcel's TEP Fleet Charging Optimization Example Project

The project described below is an example of the type of transit focused work Xcel would pursue under their RIP Portfolio.

"Transit agencies will evaluate how to best manage their charging for smarter and more cost-effective strategies moving forward and as their fleets grow. The results of this project can also help to identify different approaches to grid integration as more electric transportation options become available. Further, this work can also influence the vendor market and how demand management capabilities are developed."

Advisory Services

Fleets

Xcel plans to support in the development of electrification plans. This will help agencies understand which vehicles may be ready to transition to electric, identify effective infrastructure locations, and provide guidance on rates and charging.

Community Planning

Xcel will provide planning support to assist communities in developing EV readiness roadmaps, supporting fleets, and evaluating potential locations for siting public charging infrastructure. It is anticipated that service could be offered to sixty communities.

Fleet Advisory and Assessments

Xcel will provide information, data, and technical assistance to help inform public and private fleet electrification. These efforts will also include guidance on drafting electrification plans, and more detailed recommendations on procurement plans, charging infrastructure, and guidelines for optimizing vehicle usage and charging.

Xcel has committed to work with transit agencies to monitor key vehicle performance indicators including fleet vehicle age, miles travelled, dwell times, GPS routes, fuel efficiency, idling time, and any other relevant data. These indicators will be used as the basis for guidance on replacing vehicles with EV models.

Eligibility for Fleet Advisory and Assessment Services include:

- Being an electric customer of Xcel Energy
- Operating a fleet (defined as more than five vehicles) used to provide or distribute services or products
- Sharing aggregate data collected and used for the assessment, recommendations, internal stakeholder key decisions, and procurement documents for EV and/or infrastructure projects

Low Income Elements

Xcel states that it recognizes the role it must play in addressing emissions and air pollution in underrepresented communities. Specific initiatives developed to aid low-income communities are specified as a part of the TEP. One major transit specific initiative is support for electric public transportation through partnerships with public transit authorities. Partnerships like these will help to lower costs for EV Supply Infrastructure and related charging equipment, and help more agencies transition to cleaner transit options. Xcel will continue to evaluate the disproportionate impact emissions related pollution has had on low-income and other historically underrepresented communities and modify future plans to provide greater impact in specific areas of the State.

Eligibility

Commercial fleets would need to demonstrate that they qualify for the non-profit energy efficiency program or that they are a public organization seeking to provide accessible and affordable service for low-income communities.

Enhanced Advisory Services for Fleets

Xcel plans to proactively conduct outreach to specific transit agencies that serve low-income communities and other historically underrepresented populations. Advisory Services will be provided at no cost to customers.

Commercial Rebates

Rebates would be offered to transit agencies that provide service to low-income communities to cover the entire cost of charging equipment needed for transportation electrification.

Medium/Heavy Duty Rebates

Rebates would cover a large portion of charger costs and would be provided to customers that operate large transit fleets that serve low-income communities.

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Appendix H.

ZEV Financial Modeling

Table 1: ZEV Financial Modeling

Type Replacement	Cost	Charger Type	Charger Unit Cost	Charger Install	Total Charger	Non-ZEV Equiv.
Articulated Bus	$1,200,000	Level 3	$45,000	$40,000	$85,000	$850,000
Standard Bus	$800,000	Level 3	$45,000	$40,000	$85,000	$500,000
Small Bus	$525,000	Level 3	$45,000	$40,000	$85,000	$400,000
Large Cutaway	$250,000	Level 2	$5,000	$15,000	$20,000	$150,000
Standard Cutaway	$170,000	Level 2	$5,000	$15,000	$20,000	$90,000
Passenger Van	$150,000	Level 2	$5,000	$15,000	$20,000	$60,000
Electric SUV	$35,000	Level 2	$5,000	$15,000	$20,000	$30,000
Motorcoach	$850,000	Level 3	$45,000	$40,000	$85,000	$500,000

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Appendix I.

Transit Agency ZEV Survey Summary

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Colorado Transit Agency ZEV Survey Summary

In June 2021, an online survey was distributed to transit agencies to gather information about the current inventory of transit Zero Emission Vehicles (ZEV), ZEV transition plans, and barriers and opportunities. The survey was sent to 60 transit agencies on June 3, 2021, and closed on June 16, 2021, with reminder emails sent to agencies two times prompting them to complete the survey. Transit agencies completed 54 surveys, resulting in a 90 percent response rate. This document summarizes survey results, other key findings about lessons learned, and how the State can better support local agencies through the transition to ZEV.

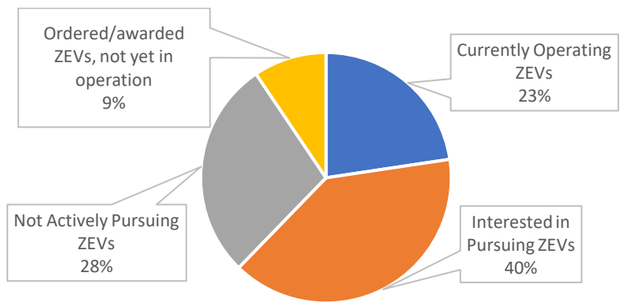
Survey Results

Q. What stage is your agency at in terms of transitioning to ZEVs?

The first survey question posed to respondents focused on identifying at which stage their respective agencies are in terms of transitioning to a ZEV fleet. Approximately 40 percent of surveyed transit agencies are interested in pursuing ZEVs, followed by almost 30 percent that said they are not actively pursuing ZEVs. Just over 20 percent of respondents are currently operating ZEVs, and almost 10 percent have ordered or been awarded funding for ZEVs but they are not yet in operation.

What stage is your agency at in terms of transitioning to ZEVs?

	Number of Agencies	Percent of Agencies
Currently Operating ZEVs	12	23%
Interested in Pursuing ZEVs	21	40%
Not Actively Pursuing ZEVs	15	28%
Ordered/awarded ZEVs, not yet in operation	5	9%



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Q. What stage is your agency at in terms of transitioning to ZEVs? (continued)

Respondents who are not actively pursuing ZEVs provided more information about potential barriers they face and/or why the transition to ZEVs may not be feasible for their agency at this time. Three key themes emerged:

- Challenges with obtaining funding and/or other resources for ZEV deployment and maintenance in rural areas
- Recent purchase of new vehicles for their fleet that will not be replaced anytime soon
- ZEV travel and charging range would be difficult for the routes they operate due to the expansive service areas, terrain, and other unique local challenges

Q. Please indicate how many ZEVs your agency is OPERATING from the following manufacturers.

Respondents provided information on the quantity and manufacturer of ZEVs currently in operation in each of their transit agencies. Nearly 60 percent of the ZEVs in operation in the State are manufactured by Build Your Dreams (BYD) and are owned and operated by the Regional Transportation District (RTD). Proterra manufactured buses make up a little over 20 percent of the ZEVs currently in operation, New Flyer buses represent almost 13 percent of buses in operation, and almost 5 percent of the buses in operation in the State are manufactured by Gillig. Currently, all ZEVs in operation are owned by transit agencies. Vehicles in the "Other" category include one ZEV from Hometown Trolley and 71 Doppelmayr/CWA gondola cabins.

Please indicate how many ZEVs your agency is OPERATING from the following manufacturers.

	Number of Vehicles	Percent of ZEVs Operating
Own – BYD	36	57%
Own - Gillig	3	5%
Own - MCI	0	0%
Own - New Flyer	8	13%
Own - Proterra	14	22%
Own - Van Hool	0	0%
Lease - BYD	0	0%
Lease - Gillig	0	0%
Lease - MCI	0	0%
Lease - New Flyer	0	0%
Lease - Proterra	0	0%
Lease - Van Hool	0	0%
Other*	2	3%

*Vehicles in the "Other" category include one ZEV from Hometown Trolley and 71 Doppelmayr/CWA gondola cabins.

Q. Please indicate how many ZEVs your agency HAS ON ORDER from the following manufacturers.

Respondents provided further detail on the number and manufacturer of ZEVs on order to be deployed in the coming months. Over 60 percent of the buses currently on order are manufactured by Proterra. Gillig buses make up a quarter of the buses on order, and one agency has not finalized procurement at this time but anticipates they will add either Proterra or Gillig zero emission buses to their fleet. Additionally, one other ZEV is on order from Hometown Trolley. Respondents indicated that there are no ZEVs on order that will be leased at this time.

Please indicate how many ZEVs your agency HAS ON ORDER from the following manufacturers.

	Number of Vehicles	Percent of Vehicles on Order
Own - BYD	0	0%
Own - Gillig	4	25%
Own - MCI	0	0%
Own - New Flyer	0	0%
Own - Proterra	10	63%
Own - Van Hool	0	0%
Lease - BYD	0	0%
Lease - Gillig	0	0%
Lease - MCI	0	0%
Lease - New Flyer	0	0%
Lease - Proterra	0	0%
Lease - Van Hool	0	0%
Other	2	13%

Q. Please indicate the number/type of vehicles currently OPERATING in your ZEV fleet.

As previously stated, RTD has the largest number of ZEVs currently in operation in the State, with thirty-six 45-foot electric buses. RTD electric buses, along with eight passenger aerial tramway gondola cabins, make up close to 65 percent of the responses under "Other." A quarter of respondents are operating 40-foot electric buses, 7 percent of ZEVs are 35-foot electric buses, and less than 3 percent are 30-foot electric buses.

Q. Please indicate the number/type of vehicles your agency HAS ON ORDER for your ZEV fleet.

Twenty electric buses are on order with ten 40-foot (including one agency with funding for two vehicles but who have not decided on a manufacturer) and ten 35-foot electric buses. One electric cutaway and one 30-foot electric bus are also on order.

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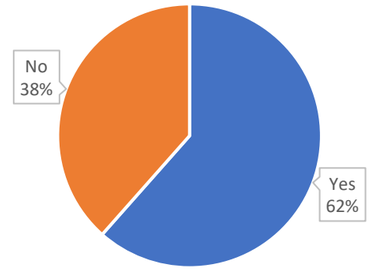
Q. For the Battery Electric Buses (BEBs) in your fleet, please indicate the type and number of chargers that you are/will be using.

When respondents were asked about the type of charging equipment used for BEBs in agency fleets, over 50 percent of chargers (39) are plug-in multi-port charging infrastructure already installed in maintenance/storage facilities. Approximately 23 percent (17) of chargers use plug-in single port charging infrastructure. A little over 12 percent of charging infrastructure is planned for plug-in multi-port charging equipment, while almost 7 percent of planned infrastructure will install plug-in single-port charging equipment. Less than 3 percent of installed or planned charging infrastructure is overhead pantographs, and only one inductive charger is installed at a maintenance/storage facility.

Q. Does your agency use (or are you planning to use) smart-charging? Smart-charging defined: technology systems that actively monitor and manage fleet charging to optimize state of charge and energy consumption.



Over 60 percent of respondents indicated they are or are planning to use smart charging technology for their BEBs. An additional 38 percent do not and/or have not planned for integration of smart charging.

Q. Do you have any advice or lessons learned to share with other Colorado transit agencies considering adding ZEVs to their fleet?

Respondents were asked to share any advice and/or lessons learned for other transit agencies considering adding ZEVs to their fleet. Respondents provided a wide range of valuable feedback that demonstrated the level of planning, support, and funding needed to make ZEV transitions sustainable and accessible across the State. Eight overarching themes emerged from the agency feedback, including:

- Create a Fleet Electrification/Readiness Plan (detailing infrastructure, maintenance, safety, and staff needs)
- Ensure planned and future maintenance, storage, and other facilities such as park-n-rides accommodate infrastructure and charging needs
- Plan for route modifications to accommodate for different charging requirements and prepare for potential level of service changes
- Consider co-locating on-route bus chargers and public chargers
- Use the expertise and experience of other agencies that have integrated ZEVs into their fleets

- Enroll in BEB/ZEV training courses and provide adequate training, resources, and guidance for staff
- Understand and plan for local and regional electric utility costs
- Establish long-term goals

Q. Would you be interested in connecting with other Colorado transit agencies operating the same ZEVs as your agency?

As highlighted in the themes listed above, collaboration across sectors, partners, and potentially other transit agencies will be key in helping to transition to cleaner mobility options. When asked if interested in connecting with other Colorado transit agencies operating the same ZEVs as their agencies, almost 80 percent of respondents are interested and would like more communication with other service providers.

Q. Does your agency have a ZEV specific fleet transition plan?

When asked if their agency has a ZEV specific fleet transition plan, the results are almost evenly split, 53 percent of agencies surveyed do not, while 46 percent do. Additionally, agencies were questioned on whether they are planning to develop a ZEV specific transition plan. Most respondents, approximately 64 percent, plan to develop or update a ZEV specific transition plan.

When asked to provide more information about the status of the transition plans, respondents explained that ongoing coordination and next steps are being finalized, vehicle and charging infrastructure options are being explored, and more time is needed to allow technology to catch up with specific fleet needs like the integration of zero emission paratransit vehicles.

Close to 36 percent of respondents who answered this question are not considering developing a transition plan because infrastructural needs and the limited range of ZEVs are difficult in a rural environment. Respondents also noted that a ZEV transition plan is not being pursued because fleet additions are not currently planned for the agency or access to funding is a barrier to agencies and they will not prioritize an effort like this at this time.

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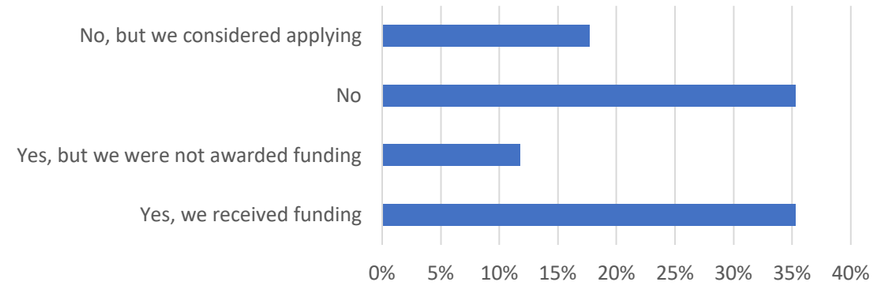
Q. Has your agency applied for ZEV funding?

Respondents were asked to provide more information about their experience in applying and obtaining funding for ZEVs. An equal number of agencies have applied and received funding as those who have never applied for funding. Almost 20 percent of respondents have not applied but have considered applying for funding, and nearly 12 percent of agencies have applied but were not successful in obtaining ZEV funding.

ZEV Funding Summary



Q. Have you coordinated with your electric utility provider regarding ZEVs?

More questioning on the types of coordination that have taken place revealed that almost 45 percent of respondents have coordinated with their electric utility provider regarding ZEVs and approximately 55 percent of respondents have not. Of the agencies that have coordinated with their utility provider, two agencies reported that their utility provider reached out to them, while 22 reached out directly to their utility provider.

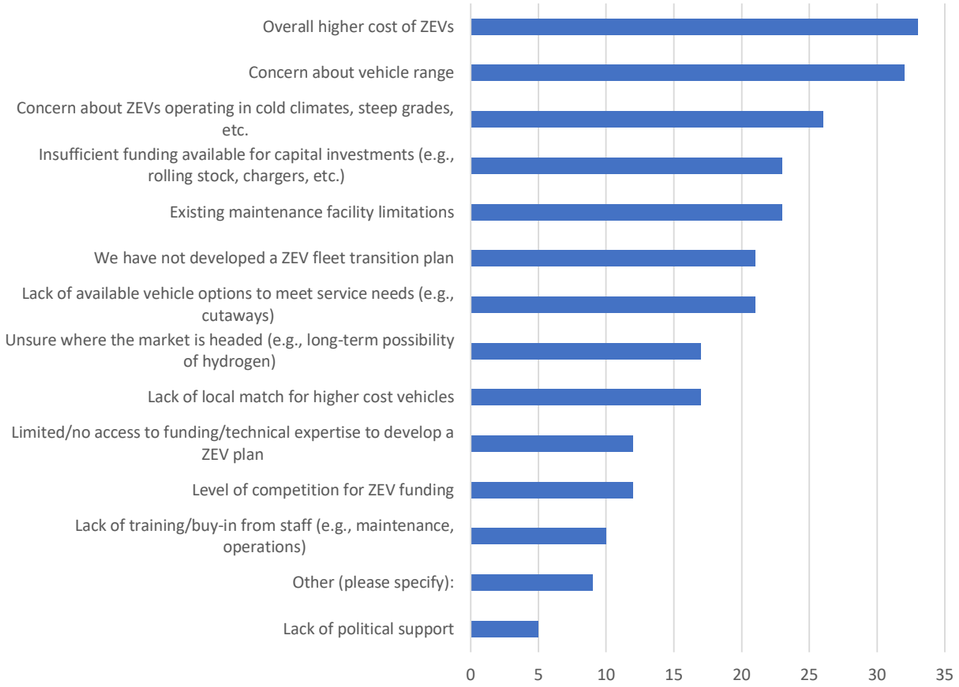
Q. What are your agency's major barriers to full ZEV fleet transition?

Barriers to full ZEV fleet transitions range from factors such as environment/terrain, funding, and size of service area. Respondents were asked to identify all potential barriers they have, or believe they will encounter, when transitioning to a full ZEV fleet.

The results show that most respondents are concerned with the **high cost of ZEVs** and the **vehicle range** needed to cover sometimes expansive rural service areas. Similarly, the other frequently identified barrier focused on the **uncertainty of ZEVs operating in cold climates, steep grades, and other challenging environments**. Existing maintenance facility limitations and insufficient funding available for capital investments were also seen as major barriers to a ZEV fleet transition.

Other factors identified with greater frequency as potential barriers include lack of vehicle options to meet service needs and not having developed a ZEV transition plan. The complete results follow.

Barriers to Fleet Transition



Q. Please rank the primary benefits and/or drivers that support/would support your agency's transition to ZEV (1 being highest priority and 6 lowest).

Respondents ranked different benefits and/or drivers according to their agency's highest and lowest priority for transitioning to a ZEV fleet. Respondents identified **environmental benefits** as their highest priority, followed by the potential for **reduced maintenance needs/costs**. Being able to reduce operating costs, passenger experience/comfort, and innovation were the following ranked benefits. Respondents selected compliance with emission regulations as the lowest ranked benefit/driver for a ZEV fleet transition.

Agency Ranked Benefits/Drivers of ZEV Fleet Transition

1. Environmental (e.g., air quality, noise)
2. Potential for reduced maintenance needs/costs
3. Potential for reduced operating costs
4. Passenger experience/comfort
5. Innovation
6. Compliance with emission regulations

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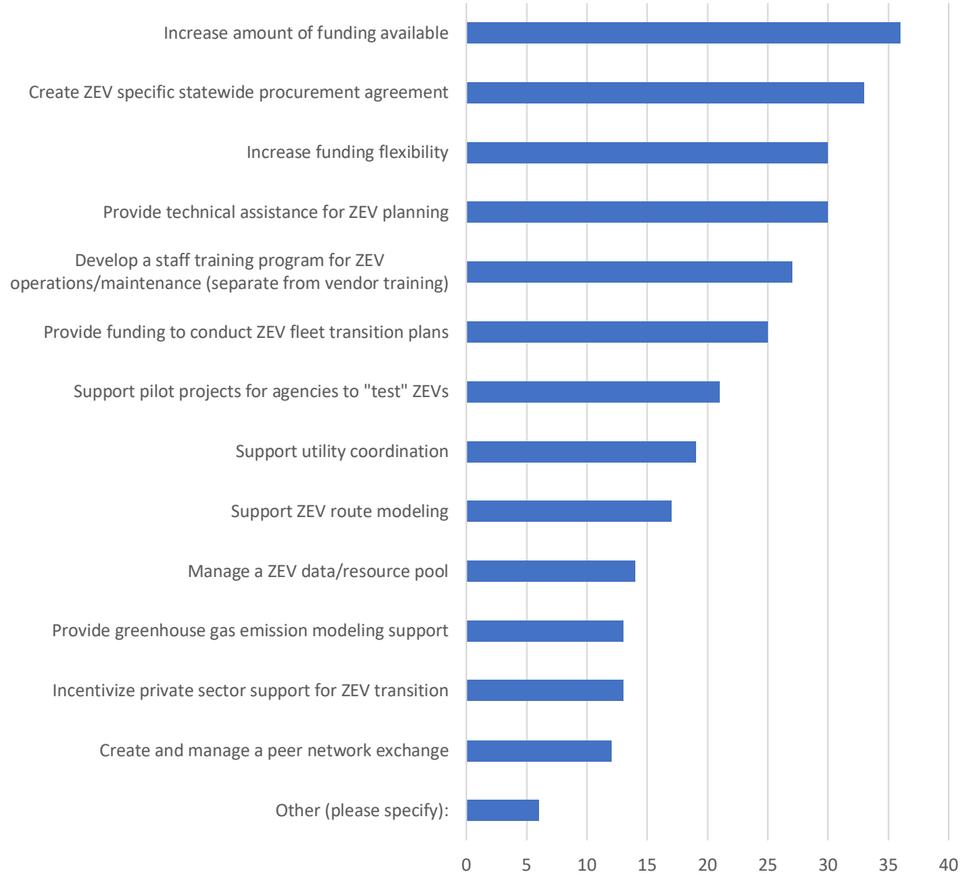
Q. How can the State best support your agency's transition to a ZEV fleet? Select all that apply.

The last survey question asked respondents to select action items that the State could act on to support their agency's transition to a ZEV fleet. Respondents identified i**ncreasing the amount of funding** as the best way to support local transit agencies. This aligns with previous survey responses that named the high cost of ZEVs as the biggest barrier in being able to transition to a ZEV fleet. Respondents also selected c**reating a ZEV specific statewide procurement agreement**, **increasing funding flexibility**, and **providing technical assistance for ZEV planning** as the most helpful action items the State could undertake. The following chart identifies the full list of actions, along with their corresponding scores.

Preferred State Actions to Support Transit ZEV Transition



General Comments/Questions

- The State needs to be aware that very rural communities and metropolitan areas do not have the same needs
- Utility coordination is the LARGEST delay in this process.
- All of these items are important for overall transition. Have been able to accomplish some on our own, but full scale modeling and assistance could be useful to those starting the journey. Negotiated transit charging rates with utilities would be very useful. How about at State level?
- We will definitely consider converting once the range is increased on commuter buses so that we can run our route efficiently.
- I think it is great that the State is really helping to drive the Transit ZEV transition. It's great to have support at the State as we are trying to implement locally. We really need to ensure more funding is available for all agencies to purchase these more expensive vehicles and improve facilities to all of fleet charging.
- Range limitations are a concern. Lack of local maintenance staff/capabilities is a major obstacle. Without sufficient private sector need, rural transit providers cannot sufficiently support a properly trained maintenance staff or service.
- I think this is going to be a great transition; however, the technology in the vehicles needs to catch up to the charging station grant process and infrastructure.
- How would batteries that are no longer viable be disposed of?
- More state funding in addition to federal funding is needed. Often less than 50% can be obtained from the feds, if any at all. Colorado needs to provide bold action beyond the settlement funds if we are going to be successful in reaching our 2030 goals.
- We need competitive cutaway options on the state contract to promote easy procurement. Technical assistance provided through CASTA's RTAP scholarship has been really helpful.
- The evolving technology in electric propulsion makes it more difficult to transition to ZEV's too early. Lack of range is one of the biggest problems. Longer range (hydrogen, better battery technology, etc.) is the key to ZEV transition. The large size of RTD's fleet and number of facilities makes it significantly more complicated to create a ZEV transition plan.
- Unsure if CNG vehicles that run on recaptured CNG (RNG) are considered zero emissions vehicles. We feel that it should be, given that this is a net zero fuel source. It may be a good option for many communities. Currently the RNG is about 30% of our total fuel consumption, and a new storage project completed this year should increase this significantly. RNG should be a part of the ZEV discussion, and resources to transition/develop/expand these programs should be available for Colorado agencies.
- Small fleet with vehicles well under FTA useful life. Not eligible for replacement under current DTR criteria.