Regional Transportation Commission
of Washoe County

April 2022

Electric Vehicle and Alternative Fuel
Infrastructure and Advanced Mobility Plan

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1 Introduction

Advancements in transportation technologies such as alternative fuels, connected and automated vehicles, and roadside infrastructure stand to change transportation networks worldwide. To best prepare for continued growth in the alternative fuel and advanced mobility sectors, the Regional Transportation Commission of Washoe County (RTC) developed this *Electric Vehicle and Alternative Fuel Infrastructure and Advanced Mobility Plan*.

This plan investigates advanced mobility solutions that can be implemented in Washoe County to create a more convenient, connected, equitable and sustainable transportation network. It is divided into the following chapters:

- **Chapter 1** introduces this plan and its purpose.
- **Chapter 2** identifies the vision, mission, and goals of this plan.
- **Chapter 3** describes the outreach activities carried out during the development of this plan, including meetings with regional stakeholders and members of the public.
- **Chapter 4** identifies existing policies and initiatives regarding advanced mobility and describes the current state of electric and alternative fuel vehicle infrastructure, connected vehicles, and mobility services across Washoe County.
- **Chapter 5** evaluates the impacts of alternative fuel and advanced mobility technologies on safety, air quality, equity, and the commercial fleet industry.
- **Chapter 6** discusses how to incorporate emerging technologies in travel demand modeling to inform transportation network planning.
- **Chapter 7** identifies opportunities and recommendations that the RTC can implement as it works toward achieving its vision for the future of the regional transportation network.
- **Chapter 8** provides guidance for the RTC in implementing the recommendations identified in this plan.

This plan will guide the RTC to integrate emerging technologies and advanced mobility solutions into the regional transportation framework. Some of the recommendations identified in this plan were developed to be primarily under the control of and led by the RTC. Other elements would be led by various partner entities. Support from jurisdictional and agency stakeholders and the public will be an essential component of the RTC's success. This plan should be used by the RTC to encourage those partner groups to participate in preparing Washoe County for the future of transportation in Nevada and across the United States (U.S.).

2 Vision, Mission, and Goals

The plan vision, mission, and goals identify the needs of Washoe County and opportunities to best address them. They were developed in coordination with a stakeholder working group and reflect the needs of the Washoe County community at large.

2.1 Vision

The vision describes the future state of the transportation network that the RTC hopes to achieve. It aims to answer the question, "How will the region benefit from this plan?" Incorporating stakeholder input, the vision of this plan is to:

> *"Enhance transportation safety, efficiency, sustainability, and equity in Washoe County through the effective application of emerging innovative technology and mobility solutions."*

2.2 Mission

The mission describes the plan's purpose. It aims to answer, "What are we working towards?" The mission of this plan is to:

> *"Outline the steps necessary to design and integrate emerging innovative mobility solutions in Washoe County within the planned and existing transportation network."*

2.3 Goals

Goals are broad, qualitative statements regarding what the RTC aims to achieve. The strategies presented in this plan were developed to help the RTC reach its goals in support of its vision and mission.

1. **Support** electric and alternative fuel vehicle adoption by making charging and alternative fueling sites as accessible and convenient as gasoline fueling stations.
2. **Promote** advanced mobility solutions that benefit the broad range of Washoe County residents, visitors, and workers.
3. **Prioritize** equity when planning for the future of transportation in Washoe County.
4. **Improve** awareness of electric, alternative fuel, connected, and autonomous vehicles among individuals and businesses in Washoe County.
5. **Address** financial and other barriers to adopting emerging technologies for residents, visitors, and workers in Washoe County.
6. **Provide** an industry-leading transportation network that integrates emerging technologies to promote safe and efficient travel in and across Washoe County.
7. **Promote** the success of regional freight corridors in and through Washoe County by supporting and incorporating emerging technologies in the trucking industry.
8. **Identify** the impacts of advanced mobility solutions on travel behavior and understand how to integrate them into the planning process.

3 Outreach Activities

Community involvement and support was essential to RTC's development of this plan. To this end, a stakeholder working group was established to review progress and offer input into the opportunities and challenges associated with emerging technologies. The public was also offered the chance to review and comment on the plan during its development.

3.1 Stakeholder Working Group

The first stakeholder working group meeting was held on Tuesday, February 9, 2021. After receiving an overview of the plan's development, attendees were asked to join "breakout" groups to discuss the biggest mobility challenges in Washoe County and the barriers to implementing solutions. The groups noted that communications infrastructure may form a barrier to connected technologies, and that a data management plan should be developed to determine how to route and process incoming data efficiently and effectively. The cost of this infrastructure and data management was identified as a barrier to implementation, particularly because infrastructure would need to cover the rural areas that form much of Washoe County. Therefore, micromobility may be hard to implement outside urban areas, with the most success likely occurring in the Reno/Sparks downtown cores.

A second meeting was held with the stakeholder working group on Wednesday, May 5, 2021. Attendees were presented a summary of existing conditions related to advanced mobility and the impacts of advanced mobility on the future of travel in Washoe County. The working group was given the opportunity to comment on a set of preliminary goals, offering input on the language to best reflect both what Washoe County desires and what it can realistically accomplish. Other discussed topics included a new joint pilot project to automatically report infrastructure issues by using camera-equipped buses, building codes in relation to charging equipment installations, equity in access to emerging technologies, and the mobility needs and limitations of senior groups. Connectivity in rural and backcountry areas was identified as a concern, as was the importance of cultural sensitivity and accommodating Nevada's large Hispanic population. Opportunities identified by the working group include electric vehicle (EV) charging at gas stations; carsharing on academic campuses; inclusion of smaller groups that provide transit, such as faith-based groups; and technical training for seniors adapting to new technologies.

A third stakeholder working group meeting was held on Thursday, August 24, 2021, to discuss the preliminary recommendations for the plan. The working group asked questions and provided input on the recommendations. Much of the input was related to how the implementation of the recommendations can be a coordinated effort between the RTC and its partner agencies. This input was incorporated into the recommendations and an action plan to support their strategic implementation.

3.2 Public Review

A draft of this plan was available online for public review from December 30, 2021, to January 5, 2022. No comments were received; the plan was finalized following this review period.

4 Existing Conditions

To develop recommendations for the RTC for promoting and utilizing emerging technologies, it is important to understand current policies and initiatives at the local, state, and federal levels. It is also important to know the current state of electric and alternative fuel vehicle infrastructure, connected vehicles, and mobility services in Washoe County.

4.1 Policies and Initiatives

As new technologies emerge to solve today's transportation issues, governments and agencies must keep up by enacting legislation and initiatives to support and promote their adoption. Existing policies and initiatives in place relevant to Washoe County include:

Nevada Clean Diesel Program[1]

In 2008, the Nevada Department of Environmental Protection (NDEP) launched the Clean Diesel Program to help reduce emissions from the State fleet of publicly and privately owned diesel-powered equipment. The Clean Diesel Program has three fundamental goals:

- **Deliver** significant reductions in diesel emissions in terms of tons of pollution produced and diesel emissions exposure from vehicles, engines, and equipment operating in areas designated as poor air quality areas.
- **Reduce** the exposure of sensitive populations to the harmful components of exhaust emissions from diesel-powered vehicles.
- **Reduce** diesel emissions to help improve and maintain air quality in communities across Nevada.

The NDEP recently partnered with the Clark County School District and the City of Reno to support the early retirement and replacement of 11 program-eligible diesel-powered school buses and five program-eligible diesel-powered municipal service vehicles.

Electric School Bus Incentives[2]

The Electric School Bus Incentives program was designed to assist school districts in the Nevada Energy (NVE) service area to replace diesel engine school buses with battery electric school buses and to install supporting charging infrastructure. Compared to diesel, electric school buses have lower maintenance costs and avoid an average of 54,000 pounds of CO2 emissions per year. Inside air quality is also improved by a factor of six compared to diesel engine school buses. This program provides incentives that can cover up to 75 percent of the total cost to buy a new battery electric school bus and related charging infrastructure.

Since the start of 2020, NVE has collaborated with the NDEP to inform school districts about funding available through the Nevada Clean Diesel Program and Volkswagen Clean Air Act Civil Settlement fund. Washoe County School District (WCSD) is participating in the program and has applied for funding of two electric school buses and two fast-charging stations.

Volkswagen Settlement Funding[3]

The State of Nevada is receiving $24.8 million through the 2017 Volkswagen Clean Air Act Civil Settlement to fund projects that will offset the excess pollution emitted by Volkswagen vehicles across the state. The NDEP has allocated the maximum amount allowed under the Volkswagen Environmental Mitigation settlement (15 percent of the funds) to electric vehicle supply equipment (EVSE). Other potential actions identified by the NDEP include:

- **Facilitating** transformative change by prioritizing EV and EVSE projects rather than diesel replacements.
- **Prioritizing** Phase 2 allocations to electric models.
- **Maintaining** the maximum investment of 15 percent in EVSE.
- **Evaluating** the Beneficiary Mitigation Plan (BMP) funding priorities annually to account for increased EV availability.

Electric Vehicle Infrastructure Demonstration Program[4]

In 2019, Senate Bill 299 created the Electric Vehicle Infrastructure Demonstration (EVID) program that requires public utilities to submit an annual plan to the Public Utilities Commission of Nevada that identifies how they will carry out the program in their service area. The utility's plan is authorized to include measures that promote or incentivize the deployment of EV infrastructure, including, without limitation, the payment of an incentive to a customer of the utility that installs or provides the infrastructure.

The EVID program helps make residential EV charging more accessible, particularly for low-income residents and those living in apartments and condos, with new incentives offered by NVE. The developers of new low-income multifamily dwellings will receive the lesser of $10,000 per Level 2 charging port or 100 percent of the total project cost for two to four ports, with a maximum incentive per project of $40,000. The program had a total budget of $150,000 for 2020. In addition, the EVID program allocated funds for the Nevada Electric Highway program along US 95 between Las Vegas and Reno, with a maximum of $500,000 available per charging site.

Electrification Coalition Roadmap[5]

In 2020, the Electrification Coalition launched the State EV Policy Accelerator initiative to engage five states (Michigan, Nevada, North Carolina, Pennsylvania, Virginia) to develop a replicable model advancing EV adoption through policy and fleet-scale development. The effort would involve stakeholder convenings between state and local government officials with the intention of outlining a path forward to navigate roadblocks and address challenges.

The Electrification Coalition conducted the Nevada EV Policy Bootcamp on December 9, 2020, during which nearly 100 EV policymakers, industry experts, and advocates joined for a collaborative day-long session about how to accelerate adoption of EVs in Nevada. The bootcamp focused on national and industry trends for EVs, including national transportation electrification needs; local opportunities; the impacts of EVs on air quality and public health; and equity concerns. The discussion of local opportunities included the vision for EVs in Nevada, utilities involvement, and near-term policy actions.

Executive Order 2019-22 – Advancing Nevada's Climate Goals[6]

On March 12, 2019, the State of Nevada joined the U.S. Climate Alliance and committed to supporting the United Nations' climate goals established at the 2015 Paris Climate Change Conference. Executive Order 2019-22 set a primary goal to reduce greenhouse gas (GHG) emissions to 28 percent below 2005 levels by 2025 and to 45 percent below 2005 levels by 2030. It also called for a statement of policy options needed to reach the emission reduction goals. As part of the U.S. Climate Alliance, Nevada would implement policies to reduce GHG emissions, track and report progress on its efforts to achieve GHG emission reduction goals, and accelerate policies to reduce carbon pollution and promote clean energy deployment.

Clean Cars Nevada[7]

In June 2020, the NDEP announced the start of a rulemaking process to evaluate adoption of low- and zero-emission light-duty vehicle (LDV) standards. Nevada adopted the California Code of Regulations, which mandate that, beginning with the 2025 model year, all original equipment manufacturers (OEM) of passenger cars, LDVs, and medium-duty vehicles (MDV) produced and delivered for sale in the State of Nevada shall not exceed the fleet average GHG emission standards set forth in the Code of Regulations.

As part of the Nevada Climate Initiative, the Clean Cars Nevada program will help advance the State's climate change and sustainability goals. Two new programs are being proposed: A Low-Emission Vehicle (LEV) program and a Zero-Emission Vehicle (ZEV) program. The LEV program would require new (as of model year 2025) passenger cars, light-duty trucks, and MDVs sold in Nevada to meet certain emissions requirements that reduce emissions of GHG emissions and criteria pollutants, including carbon monoxide (CO), nitrogen oxide (NOx), volatile organic compounds (VOC), and hazardous air pollutants (HAP). The ZEV program would include three major initiatives: A ZEV credit requirement based on average annual sales; generation of ZEV credits by OEMs; and introduction of clean vehicle technologies, such as battery electric, hydrogen fuel cell (HFC), and plug-in hybrid electric vehicles (PHEV) by OEMs. The programs are currently going through a review of the draft regulation.

Federal Tax Credit[8]

The Qualified Plug-In Electric-Drive Motor Vehicle tax credit is available to taxpayers in Nevada for PHEV and ZEV purchases until OEMs meet a specified threshold of 200,000 vehicle sales per manufacturer. It provides a tax credit of $2,500 to $7,500 for new vehicle purchases, with the amount determined by vehicle size and battery capacity.

EV-Readiness in Building and Development Codes

Some efforts have begun to incorporate EV readiness in local agency codes in Washoe County. In 2020, the City of Reno proposed a Sustainability article be included in an update to the City Land Development Code. Though this article was not adopted in 2020, the City of Reno is expected to adopt it by April 2023. Other areas in Nevada, such as Clark County, have proposed code amendments to require EV readiness but have not yet adopted them.

4.2 Vehicle Sales

According to the Nevada Auto Outlook 2019, total LDV sales in Nevada declined by 4.7 percent through 2019, consistent with national trends[9]. Light-duty truck sales continued to gain an increasing share of the market, growing from 43.2 percent in 2012 to 67.8 percent in 2019. Sales of new hybrid and EVs represented 6.5 percent of the Nevada market share in 2019. Total sales were up 25 percent for low- and zero-emission vehicles through the beginning 2019 but dropped off rapidly later in the year.

The onset of COVID-19 in early 2020 and the consequent economic slowdown drove new vehicle registrations in Nevada down by 12.7 percent from January to July compared to the same period in 2019. In the first half of 2020, the share of hybrids, battery electric vehicles (BEV), and PHEVs declined slightly—by 0.5 percent or less—relative to the same time in 2019; however, sales continued to grow. Based on the increasing sales of light-duty ZEVs, there will be increasing demand for charging infrastructure. The RTC should work to accommodate future demand by planning for and siting new public charging stations across Washoe County.

4.3 Ownership Costs

Though the up-front cost of buying an EV can be higher, lower ownership costs often fully (or even more than) offset the difference. A Consumer Reports study found that ZEVs generally cost $6,000-10,000 more than their ICE counterparts at the point of purchase, but lifetime savings can add up to $7,000-17,000. Those savings come from reduced maintenance needs, the lower cost of charging versus fueling, and less depreciation in value.

Regarding maintenance, ZEV do not require oil changes, spark plugs, or timing belts, which reduces the chance of expensive fixes being needed over time. There are also significantly fewer moving parts in a ZEV, so less ongoing preventative maintenance is required. Brake pads typically last longer on ZEVs than on ICE vehicles, and all ZEV manufacturers offer at least eight-year warranties on the batteries, if not longer.

The U.S. Department of Energy (U.S. DOE) estimates that, based on current local fuel and electricity costs, ZEV owners in Nevada pay up to 78 percent less to charge than ICE owners do to fuel.[10] Additionally, although it is often assumed home charging will increase electricity costs, average savings over gasoline use are estimated at almost $800 per year.[11] In this way, removing barriers—particularly financial—to ZEV ownership can lead to lifetime savings.

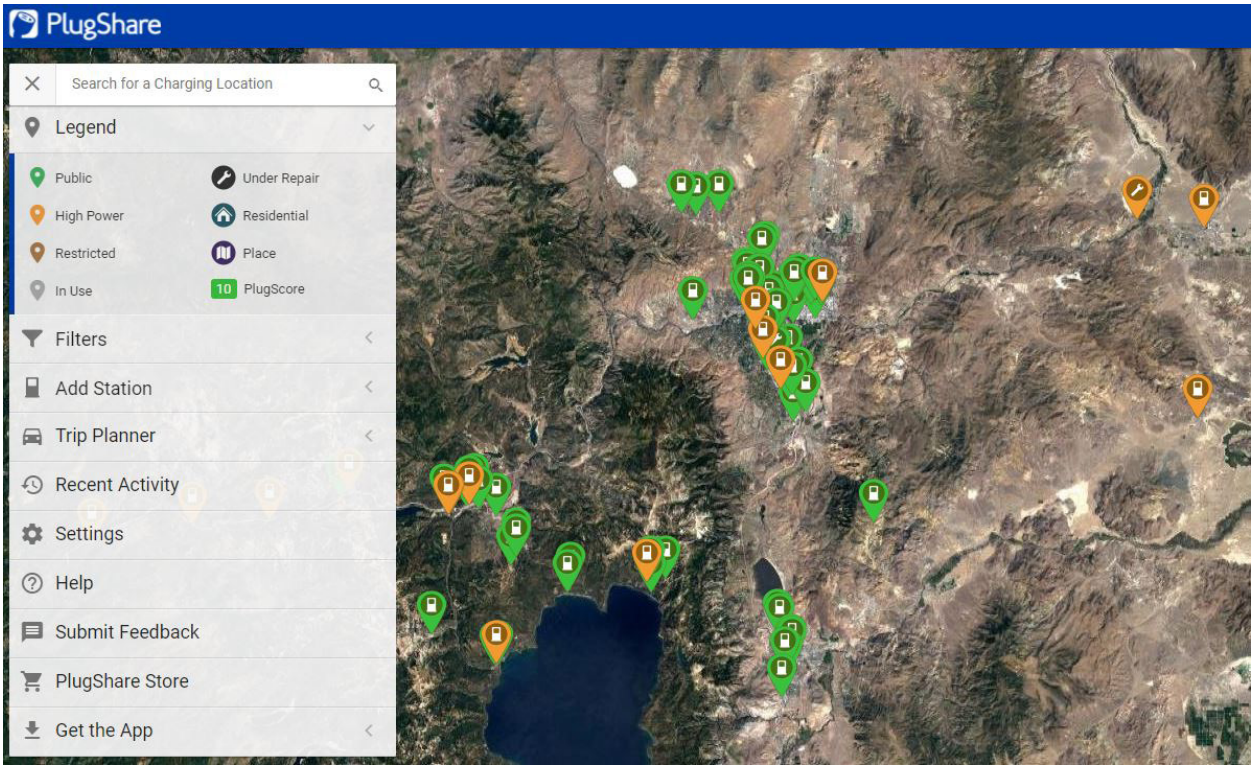
4.4 Charging Infrastructure

According to the U.S.DOE database as of February 15, 2020, there are 404 public alternative fuel stations in the State of Nevada, 94 of which are in Washoe County.[12] A breakdown of these stations by type is provided in **Table 1; Figure 1** shows the stations on a regional map.

Table 1: Washoe County Charging Infrastructure Inventory

Alternative Fuel Type	Number of Stations in Nevada	Number of Stations in Washoe County
Electric Vehicle Supply Equipment (EVSE)	380 (1,117 outlets)	90 (348 outlets)
Level 2	*316 (839 outlets)*	*82 (308 outlets)*
Direct Current Fast Charge (DCFC)	*72 (278 outlets)*	*8 (40 outlets)*
Hydrogen Fuel Cell (HFC)	0	0
Compressed Natural Gas (CNG)	3	1
Ethanol (E85)	10	0
Biodiesel (B20 and Above)	0	0
Liquefied Natural Gas (LNG)	0	0
Propane (LPG)	11	3

Figure 1: Washoe County Charging Infrastructure Map



Source: PlugShare

The State of Nevada plans to expand EV adoption across the state, not just in densely populated areas. The State and NV Energy have partnered to implement the Nevada Electric Highway (NEH) joint initiative to increase access to charging infrastructure between major urban centers.[13] The NEH represents the next phase in expanding charging infrastructure in Nevada to support EV owners. Completion of the NEH initiative is expected to help mitigate the range anxiety that EV owners often

feel with battery ranges that typically fall below the fuel range of an ICE vehicle. The NEH initiative was to be completed in 2020, but its status since the start of the COVID-19 pandemic is unknown. When it is done, the NEH will provide charging stations at the locations indicated in **Table 2**.

Table 2: Nevada Electric Highway Charging Station Locations

I-15	I-80	US 50	US 93	US 95
Primm	Fernley	Silver Springs	Coyote Springs	Shurz
US 93 Jct.	US 95 Jct.	Middlegate	Alamo.	Luning
Moapa	Lovelock	Cold Springs	Sunnyside	Mina
Mesquite	Mill City/Imlay	Austin	US 93A Jct.	Coaldale
	Winnemucca	Rest Area	Jackpot	Goldfield
	Battle Mountain	Eureka		SR 267 Jct.
	Carlin	NDOT ROW		Amargosa Valley
	Elko	Ely		Indian Springs
	Wells	US 93 Jct.		
	Oasis	Baker		
	West Wendover			

Once completed, the NEH will give BEV and PHEV drivers the freedom to travel the 450-mile route from Reno to Las Vegas, with charging stops along the US 95 corridor. As part of the NEH initiative, Nevada has also received acceptance from the U.S. Federal Highway Administration (FHWA) on designation of four strategic corridors as Alternative Fuel Corridors, including I-80, I-15, and US 50 in Washoe County.

Currently, there are no hydrogen refueling stations in Nevada. In contrast, in the State of California there were more than 40 retail liquid hydrogen stations as of 2019, and this number is expected to grow following the new 2035 zero-emissions mandate. The ongoing development of a regional freight route on I-80 connecting California, Nevada, and Utah through the Reno/Sparks area, combined with an expected shift in the freight industry to HFC, indicates an opportunity for the RTC to promote hydrogen to close a gap in the planned network.

In 2020, Air Liquide outlined its $200 million investment to build a new renewable liquid hydrogen plant and related logistics infrastructure in North Las Vegas.[14] With a capacity of nearly 30 tons of liquid hydrogen per day—an amount that can fuel 42,000 hydrogen fuel cell electric vehicles (HFCEV)—Air Liquide's hydrogen plant is expected to provide a reliable solution to the large-scale deployment of hydrogen mobility on the west coast. The plant will serve the complete range of ZEVs, from cars and buses to forklifts and heavy-duty freight trucks. When complete, the plan stands to offer significant support to the RTC in promoting hydrogen as an alternative fuel source in Washoe County.

Nevada has the largest lithium prospects in the U.S. and the only active lithium mine in North America, at Silver Peak.[15] Increasing global demand for battery production has prompted the mining industry to pursue an extraction enterprise at Thacker Pass, the largest known lithium resource in the country. Several entities are considering investments or have already secured rights to a lithium

claim in Nevada. According to the Lithium Americas 2018 annual report, Phase 1 of the Thacker Pass project is projected to have an annual production capacity 30,000 metric tons lithium carbonate equivalent (LCE) by 2022. Phase 2 (2026) is projected to have a capacity of 60,000 metric tons LCE per year.

4.5 Connected Vehicles

Advancements in connected vehicle (CV) technology have allowed vehicles to communicate with each other (vehicle-to-vehicle [V2V]) and roadside infrastructure (vehicle-to-infrastructure [V2I]) to improve operations and user safety by preventing dangerous situations. Automated vehicles (AV) use internal sensors to gather information about the vehicle's surroundings and operate in isolation. Connected automated vehicles (CAV) use a combination of on-board sensors and vehicle connectivity.[16]

V2V technology allows vehicles to transfer data within an ad-hoc "mesh network," or a network where a vehicle can "hop" between other vehicles to obtain data farther ahead than the range typically would allow.[17] V2V is expected to be more effective than today's systems, which rely on the functionality of on-board hardware.

V2I technology enables communications between vehicles and roadside infrastructure, such as radio frequency identification (RFID) readers, traffic lights, cameras, lane markers, lighting, signage, and parking meters. V2I is a wireless, two-way system that transfers information via Dedicated Short-Range Communication (DSRC) units. Using V2I technology, vehicles receive information on road conditions, crashes, construction zones, congestion, and parking spaces. Traffic management systems can use data originating from the vehicles to set variable speed limits and adjust signal phasing and timings to facilitate traffic flow.

V2V safety applications and the crash types they can address include:[18]

- Forward Collision Warning and Electronic Emergency Brake Light, for rear-end crashes
- Do Not Pass Warning and Left Turn Assist, for opposite direction crashes
- Intersection Movement Assist, for intersection crashes
- Blind Spot Warning/Lane Change Warning, for lane change crashes

Table 3: shows additional applications of CVs that can improve operations and safety.[19]

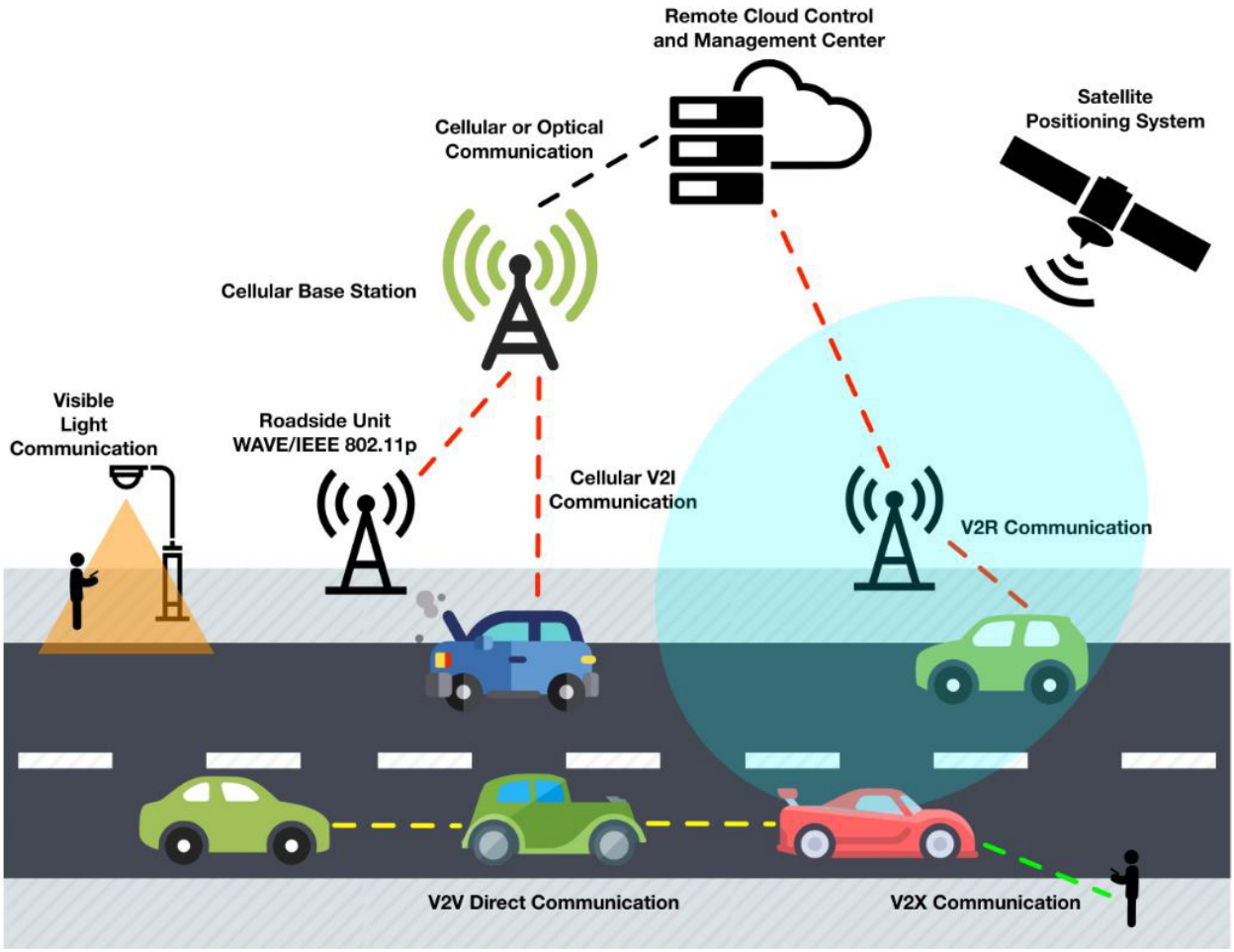
V2V Safety	Agency Data/ Enviornment	Smart Roadside/Mobility
Emergency Electric Brake Lights (EEBL)	Probe-based Pavement Maintenance	Wireless Inspection
Forward Collision Warning (FCW)	Probe-enables Traffic Monitoring	Smart Truck Parking
Intersection Movement Assist (IMA)	Vehicle Classification-based Traffic Studies	Intelligent Traffic Signal System (I-SIG)
Left Turn Assist (LTA)	CV-enabled Turning Movement & Intersection Analysis	Signal Priority (transit, freight)
Blind Spot / Lane Change Warning	CV-enabled Origin-Destination Studies	Cooperative Adaptive Cruise Control (CACC)
Curve Speed Warning	Work Zone Traveler Information	Guidance for Emergency
Do Not Pass Warning (DNPW)	Dynamic Eco-Routing (light, vehicle, transit, freight)	Emergency Communications and Evacuation (EVAC)
Vehicle Turning Right in Front of	Low Emissions Zone Managment	Connection Protection (T-CONNECT)
Buss Warning (transit)	Eco-ICM Decision Support System	Freight-Specific Dynamic Travel
Queue Warning (Q-WARN)	Eco-Smart Parking	Emergency Vehicle Preemption (PRE-EMPT)

Source: Kore University, 2019

The Institute of Electrical and Electronics Engineers (IEEE) 802.11p Standard was explicitly introduced to support Wireless Access in Vehicular Environments (WAVE) and is intended to facilitate V2V and V2I communications. Data rates can range from 6 to 27 Megabits per second (Mbps) with a short transmission range of approximately 1,000 feet. Cellular technologies have also been evaluated, specifically Long-Term Evolution (LTE) which offers download rates of 300 Mbps, upload rates of 75 Mbps, and a transmission range of around 60 miles. Other current protocols include Bluetooth and IEEE 802.15.4/ZigBee.

Vehicle-to-everything (V2X) technology encompasses V2I and V2V, as well as vehicle-to-pedestrian and vehicle-to-grid communications (**Figure 2**). Many technologies exist, but each has its limitations. Current limitations can be overcome with a Bluetooth Low Energy (BLE)-based approach and utilizing the emerging U.S. 5G network. Implementation of V2X will require partnerships between vehicle manufacturers and local and state transportation agencies to fund initiatives and infrastructure, as well as joint innovation and cross-industry collaboration. New Intelligent Transportation System (ITS) technologies will need to be integrated effectively with mobile networks and will need to be applied on less frequented roads, like those in rural areas, to cover entire states. This will be important in Nevada, which, outside of its urban areas, is largely rural and not densely populated. Examples of ITS applications in rural areas include intersection, animal, and oncoming vehicle warning systems. All these examples require a combination of sensors and active signage and, if CVs are included, the ability to transmit large amounts of data at rapid speeds.

Figure 2: Vehicle-to-Everything (V2X) Technologies



Source: Kore University, 2019

Connected vehicles create up to 25 gigabytes of data per hour, which cannot be supported by current rural networks. As of 2018, nearly 40 percent of the 60 million Americans living in rural areas lacked access to the minimum broadband standard set by the Federal Communications Commission (FCC).[20] Broadband and 5G service will need to be expanded to the less densely populated areas of Nevada to support statewide access to the benefits of CAV technologies. Agencies may consider requiring installation of fiber and/or other network-related infrastructure during roadway construction and rehabilitation projects to support more rapid expansion.

Daimler is expected to begin production of mostly autonomous (Level 4) AVs in 2025 to be used by transportation network companies (TNC), taxi services, and delivery services, but only in limited, defined areas ("geofencing").[21] As of 2020, it was estimated there is only a 50 percent chance that fully automated (Level 5) AVs are market-ready by 2040. During this long transition period, it will be necessary to track the impacts of AVs on road operations and safety, particularly at lower adoption levels. It is possible that these aspects are negatively impacted at first, then positively impacted as the prevalence of AVs grows.

Green Light Optimized Speed Advisory (GLOSA) systems provide timely information to drivers about traffic signal timings and locations so they can adjust their speed to stop less often at traffic signals.

The goal is to provide more uniform travel by optimizing and smoothing traffic flows on arterial streets, improving travel time consistency, and reducing vehicle emissions. If signal timings are fixed and known, a reduction in stopped delay of more than 50 percent could be achieved.[22] With fixed timings, a GLOSA system could offer a 27 percent reduction in overall delay and a 46 percent reduction in the number of stops. However, implementing GLOSA along an actuated-coordinated signal system could result in anywhere from just a 3 percent reduction to a 13 percent increase in stopped delay. Fuel consumption savings begin to increase at approximately 30 percent adoption and when speed advisory data is transmitted at least every five seconds.

The benefits of GLOSA systems are primarily achieved at low traffic densities where fuel savings and emissions reductions are estimated at up to 12 percent, waiting times at 17 percent, and stops at 6 percent.[23] The benefits increase linearly with the number of equipped signals and vehicles but decrease at higher densities when more unequipped drivers are present and block signals, which forces equipped vehicles to stop.

4.6 Mobility Services

The RTC currently offers eight transportation programs to promote mobility for Washoe County residents, visitors, and workers. The RTC RIDE service is the public transit system of the greater Reno/Sparks area with 24 fixed bus routes. The remaining seven programs offer service in areas where the RTC RIDE service is not immediately available.

- **RTC ACCESS—**A paratransit service providing prescheduled, door-to-door transportation for people meeting the ADA eligibility criteria. Service is provided so long as the trip origin and destination are within 3/4-mile of a "regular" fixed-route RTC RIDE service. RTC ACCESS does not operate where or when RTC RIDE does not operate.
- **RTC FlexRIDE—**A curbside-to-curbside public transit service for some areas ("zones") outside the RTC RIDE coverage area. As of October 2020, service was available in parts of the North Valleys, the Sparks/Spanish Springs area, and Somersett/Verdi.
- **RTC Smart Trips—**A free service to support local businesses in encouraging employees to use alternative modes of transportation like public transit, bicycling, walking, car and vanpooling, and telecommuting. Businesses may be eligible for federal tax deductions and employees get a tax-free benefit. The Bus Pass Subsidy Program matches an employer's contribution toward monthly bus passes up to 20 percent.
- **RTC Trip Match—**A free, web-based trip matching program for the Truckee Meadows area. Users can enter travel preferences and receive help with carpools, biking, walking, and finding "bus buddies." The program is run under RTC Smart Trips in partnership with Greenride.
- **RTC Vanpool—**A subsidized program that promotes ridesharing. A commuter van is driven by one member of a group, who picks up and drops off passengers at agreed upon locations and times. Riders share expenses and up to $3.60 per person per day is subsidized by RTC. The program is run under RTC Smart Trips and is available in the Truckee Meadows area.
- **Washoe Senior Ride—**A subsidized taxi program for residents over 60 years old, any RTC ACCESS client, and veterans. The program is funded by 1/4-percent of the County sales tax allocated for public transportation. Each month, up to $60 in fares can be bought for $15.

- **Uber Rides Pilot Program—**A subsidized pilot program for residents over 60 years old, RTC ACCESS clients, and veterans. In August 2020, RTC entered into an agreement with Uber for a one-year pilot program modeled after the Washoe Senior Ride program. RTC subsidizes 75 percent of fares up to $9 for Uber trips starting and ending in the Reno/Sparks area, up to 5 trips per month. Service is available 24/7/365.

4.7 Pilot Programs and Studies

The Nevada Department of Transportation (NDOT) and the RTC have worked with numerous partner groups to initiate pilot programs and studies for the future of transportation in Washoe County. These include electric buses and autonomous buses, communications-equipped fleet vehicles, and roadway and roadside connected infrastructure.

RTC Electrification and Connected Technologies

The RTC was one of the first transit agencies in the country to place electric buses into revenue service. In 2010, the FTA awarded the RTC a grant for $4,650,523 to support its Electric Bus Initiative through the Transit Investment for Greenhouse Gas and Energy Reduction (TIGGER) II program.[i] The RTC introduced its first four Proterra electric buses in April 2014 and saw a diesel fuel savings of nearly 52,800 gallons in the first two years of operation. With all 15 pilot buses in operation, a total fuel savings of over 2,136,700 gallons was estimated, equating to nearly $5.1 million in cost savings. An additional savings of $4.2 million was estimated due to the reduced maintenance needs of electric buses. This project has also enabled a reduction in utility demand charges associated with charging electric buses, further reducing costs for the RTC. The total savings attributed to the 15 pilot electric buses are expected to reach $10.4 million.

In December 2020, the RTC received a $131,661 research grant from the U.S. Federal Transit Administration (FTA) to demonstrate real-time transit infrastructure monitoring in the City of Reno.[ii] The funding is being used in collaboration with University of Nevada Reno (UNR) to install a monitoring system that uses 3D imaging, cameras, and light detection and ranging (LiDAR) equipment to assist the RTC in maintaining its transit system in a "state of good repair." The RTC and UNR are implementing a digital model of the RTC's transit assets citywide, including bus stations and other infrastructure. Sensors are being used on assets and RTC buses to track, identify, and address maintenance issues quickly.

Northern Nevada Intelligent Mobility Living Lab

NDOT is coordinating with the Northern Nevada Intelligent Mobility Living Lab to learn how to use big data in new technologies, and the UNR has worked with the RTC to use state-of-the-art electric buses that are instrumented with several systems to gather and integrate roadway data.[26] The Nevada Intelligent Mobility Project has used Virginia Street in Downtown Reno as a living lab to test vehicle communications using the RTC's electric buses from Proterra.[27] The project aims to determine what sensors and communication tools are needed to enable full automation in cities. The buses have been outfitted with sensors and cameras, and streetlights have been equipped with radios monitoring conditions at intersections ahead. The data will be used to develop perception algorithms that paint a picture of the travel environment around a vehicle.

The RTC has coordinated with UNR to install 360-degree LiDAR equipment along Virginia Street in Downtown Reno.[28] While conventional systems like loop and video detectors and Bluetooth sensors provide macro traffic data, do not measure vehicle trajectory, and can only provide averaged data, LiDAR sensors can detect objects with high accuracy and frequency in a range of lighting conditions.

This project used Velodyne's 360-degree "Ultra Puck" LiDAR sensors, which are cost-efficient and commercially available on the market. One or two sensors were installed on the existing traffic signal poles at eight intersections on Virginia Street and at one along McCarran Boulevard.

UNR reported the most significant achievement of the project was implementation of LiDAR-based automated Rectangular Rapid Flashing Beacons (RRFB) along Green Valley Parkway near Henderson, Nevada. Benefits of these are the collection of 24/7 traffic trajectory data and controlling the RRFB flashing. The sensors can perform traffic data collection, assist in adaptive network control, detect and record jaywalking events, and broadcast information and safety messages to CAVs. UNR found that vehicle accuracy was over 95 percent, and pedestrian accuracy was 99.5 percent. UNR is looking to provide data services to agencies, including 24/7 volume classifications, vehicle speeds, and time-space diagrams for signal efficiency improvements. This is an opportunity for the RTC to collaborate further with UNR to improve operations and safety along Washoe County roadways.

NDOT Integrating Mobile Observations Pilot Program

NDOT's launched the Integrating Mobile Observations (IMO) pilot program in 2011 that aimed to improve road safety, reliability, and mobility during winter weather events. Phase I utilized an Enhanced Digital Access Communication System (EDACS) radio system for communications. Phase II added cellular capabilities which often replaced EDACS. In Phase III, NDOT added DSRC devices to vehicles. Each vehicle equipped with multiple technologies can switch to the most effective one based on location. Challenges and their solutions identified in the case study are shown in **Table 4**. The study concludes that hybrid communications can reduce cost, leverage existing connections, and improve data access for Road Operations Centers (ROC). DSRC can be used as a cost-effective solution to augment existing communications capabilities.

Table 4: Washoe County Charging Infrastructure Inventory

Challenge	Challenge Description	Solutions
Customization	Custom software and hardware are difficult to develop, test, and maintain.	Use well-tested, commercially available software/hardware.
Infrastructure	Component configuration, addressing, and firewalls during initial setup.	Involve IT personnel with networking expertise, especially in initial setup.
Security	Vehicle network protection requires firewall, encryption, etc.	Back-end firewall, two-factor authentication, and encrypted communication.
Protocol	Newer IPv6 protocol is needed for DSRC but not all components support it.	Possible to circumvent using WAVE short message protocol or current IPv4.
Costs and Coverage	Cellular data plan costs and coverage, especially in rural areas.	Choose plans that share data usage across many devices.
Costs of Wear and Tear	Uses like snowplows are demanding on equipment.	Use rugged, not consumer-grade, components when needed.
Rural Coverage	Range of each DSRC leads to delays when transmitting long distances.	Evaluate cellular providers/plans with coverage in rural areas.

Source: Nevada Department of Transportation

Snowplow Hybrid Communications Platform Pilot Program

The U.S. Department of Transportation (USDOT), NDOT, UNR, and the National Center for Atmospheric Research (NCAR) tested a variety of communications methods between snowplows in the Tahoe/Reno/Carson City area. A Hybrid Communications Platform allowed vehicles to communicate with each other and with roadside DSRC units. The plows collected information from Road Weather Information System (RWIS) field units and shared this information with motorists through Dynamic Message Signs (DMS), traffic-focused mobile applications, and vehicle displays.

Las Vegas Autonomous Vehicle Testing

Since 2018, the joint venture Motional has tested AVs along the Las Vegas Strip, providing over 100,000 rides to date through its partnership with Lyft. Vehicles were accompanied by a safety driver who could take control if needed; however, as part of the next phase of the program, the Nevada Department of Motor Vehicles endorsed Motional to expand its geographic spread and operate its vehicles without a safety driver in November 2020.[29] The inaugural testing of the driverless vehicles began in February 2021. The RTC should consider adapting this approach to introducing AVs along Washoe County roads by beginning to develop partnerships, identify potential pilot corridors, and increase public comfort with AV technology.

Nexar Vehicle-to-Vehicle Mobile Application

Nevada is the first statewide launch of Nexar's V2V system through use of its mobile application. The system provides real-time alerts to help prevent crashes by recording video outside the vehicle and measuring vehicle dynamics. Warnings from adjacent vehicles can be communicated to other drivers through the application.[30]

5 Impacts of Advanced Mobility and Alternative Fuels

Technological advancements, such as alternative fuels and CAVs, stand to dramatically change the transportation framework in Washoe County, in Nevada, and across the U.S.. Impacts to safety, air quality, and equity must be considered as the RTC prepares for the future. With important regional freight corridors passing through Nevada, such as I-80 through the Reno/Sparks metropolitan area, it is also important to consider the impacts that changing vehicle technologies will have to the freight industry.

5.1 Safety

According to the USDOT, connected vehicles will change the way Americans travel "through the creation of a safe, interoperable wireless communications network—a system that includes cars, buses, trucks, trains, traffic signals, smartphones, and other devices."[32] They estimate that connected vehicle safety applications, such as Red Light Violation Warning and Pedestrian in Signalized Crosswalk Warning CV features, could address more than 250,000 crashes and 2,000 fatalities per year, and that the Curve Speed Warning feature could address more than 169,000 crashes and 5,000 fatalities per year. The National Highway Traffic Safety Administration (NHTSA) evaluated a scenario where 100 percent of vehicles were equipped with Left Turn Assist and Intersection Movement Assist and found that at full adoption the two technologies combined could prevent nearly 600,000 crashes and save over 1,000 lives per year.[33] Intersection Movement Assist specifically accounts for approximately 90 percent of the reductions. NHTSA estimates that the total cost passed on to each consumer for V2V-enabled vehicles would be around $350 (2014), decreasing over time to around $220 by 2058.

AV technologies are also gaining prevalence; when combined with V2V/V2I applications, even more significant safety benefits can be achieved. Each CAV safety application can generally be tied to the crash type(s) it aims to address (**Table 5**).[34] A study from the University of Texas at Austin found that 90 percent deployment of the full suite of AV measures may reduce crash costs in the U.S.by $126 billion per year and save nearly 2 million functional life-years.[35] (Functional life-years are those which are healthy and productive. Savings are a combination both severe/debilitating injuries and fatalities avoided.) The greatest potential was found in the combination of Forward Collision Warning and Cooperative Adaptive Cruise Control, which together could result in an annual economic savings of over $53 billion and almost 500,000 life-years saved per year. This suggests that the two technologies may merit priority deployment; agencies should work with OEMs to develop incentives and policies to promote adoption of these features. Cooperative Intersection Collision Avoidance Systems were also found to have significant benefits, with the potential to offer an annual economic savings of over $22 billion and nearly 1.24 million life-years saved per year.

Table 5: Crash Types and Related CAV Applications

Crash Type/Cause	CAV Safety Application
Rear-End	Forward Collision Warning Automatic Emergency Braking Cooperative Adaptive Cruise Control
Non-Compliance	Cooperative Intersection Collision Avoidance (combination of Intersection Movement Assist, Red Light/Stop Sign Violation Warning)
Same Direction	Blind Spot/Lane Change Warning
Opposite Direction	Do Not Pass Warning
Roadway Departure	Road Departure Crash Warning (combination of Lateral Drift Warning and Curve Speed Warning) Lane Keeping Assist
Roadway Obstruction	Electronic Stability Control
Reversing	Backup Collision Intervention
Bicycle/Pedestrian	Pedestrian in Signalized Crosswalk Warning V2Pedestrian/V2Pedalcyclist

Source: University of Texas at Austin, 2018

5.2 Air Quality

Today's transportation sector accounts for 23 percent of worldwide GHG emissions and 28.5 percent of U.S. GHG emissions.[36] In 2016, transportation-related CO2 emissions surpassed those from the electricity production sector for the first time; this rapidly increasing trend is the fastest of any GHG-emitting sector. Annual transportation-sector emissions are projected to double by 2050 without any mitigation. To offset this, tailpipe emissions must be a key focus of mitigation efforts.

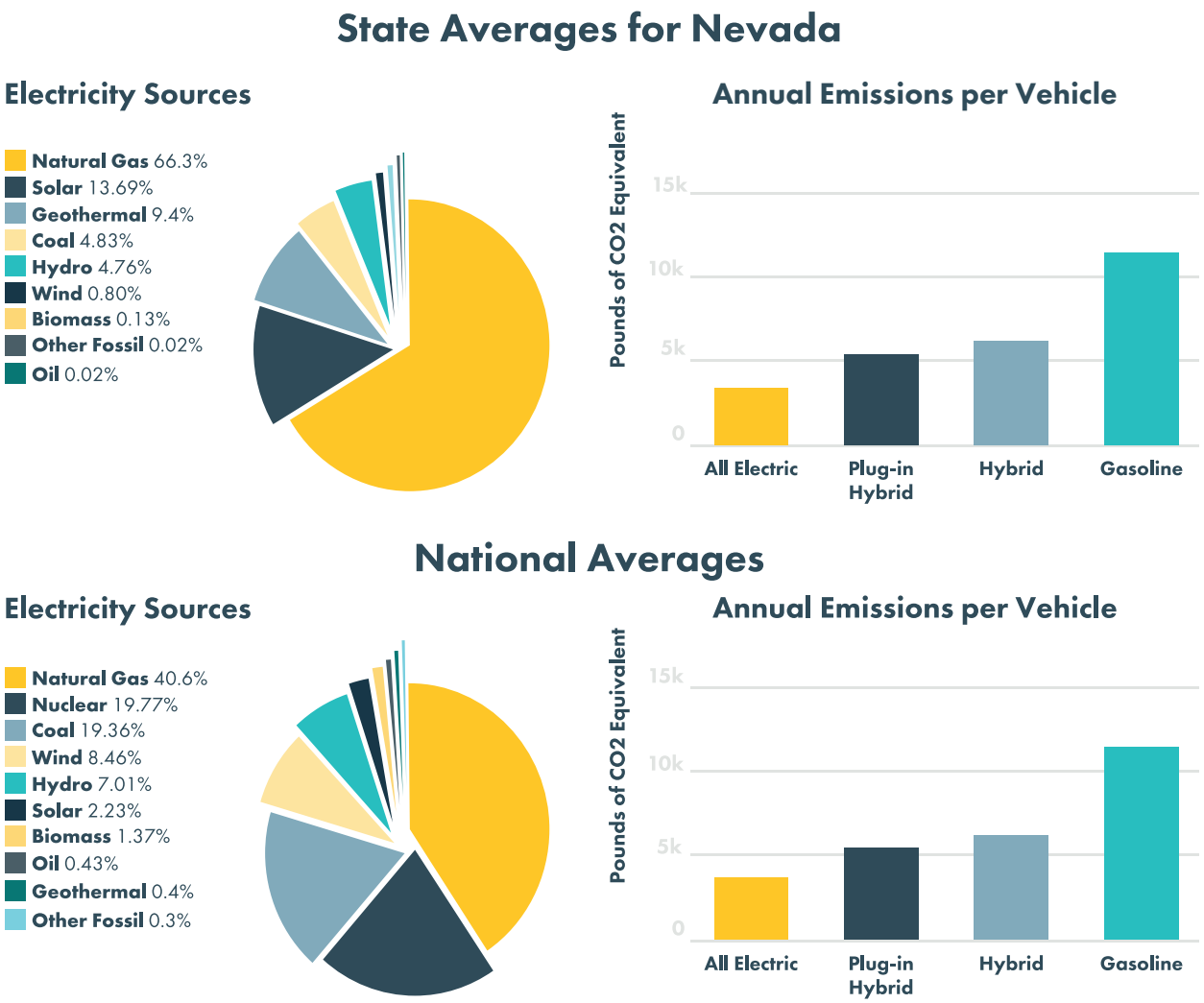
Emerging technologies, such as electric, alternative fuel, and CVs are expected to reduce fuel consumption, in turn reducing harmful vehicle emissions. Vehicle emissions can be air pollutants, which contribute to smog, haze, and health problems, and GHG emissions. Traditional vehicles produce emissions directly from the tailpipe and through evaporation from the fuel system and during fueling. EVs on the other hand produce zero direct emissions. PHEVs produce no direct emissions when in all-electric mode, but still produce evaporative emissions.

According to the U.S. DOE, using compressed natural gas (CNG) to power vehicles can reduce lifecycle GHG emissions by 15 percent, or up to 84 percent if renewable natural gas (RNG) is used.[37] EV and HFCEV lifecycle GHG emissions are mostly derived from the energy production process; depending on the energy source used lifecycle emissions they can be anywhere from significantly lower than to nearly the same as gasoline-powered vehicles. Hydrogen production, for example, can reduce GHG emissions to zero or it can increase them by 20 to 60 percent relative to ICE vehicles if typical U.S. energy production mixes are used.

The U.S. DOE website provides a calculator showing annual emissions by vehicle type per state versus the national average (**Figure 3**). Nevada is generally in line with the average, but EV and

PHEV well-to-wheel emissions are lower than the average by up to 400 pounds of CO2 equivalent. This is due to its minimal reliance on coal (favoring natural gas instead) and high use of solar and geothermal energies.

Figure 3: Emissions per Vehicle by Electricity Source



Source: U.S. Department of Energy, 2021

The Clean Air Act of 1975 (CAA) and Clean Air Act Amendments of 1990 identify air quality standards for each state. The CAA sets increasingly stringent standards over time until each area is redesignated to "attainment." To date, Washoe County's designations for CO2 and PM10 emissions have been updated from "nonattainment" to "maintenance." Under current policies, it is estimated Nevada can reduce its GHG emissions by 24 percent by 2025 and 26 percent by 2030, falling short of statewide GHG emissions reduction goals. The Nevada Climate Initiative aims to increase the pace of these reductions by identifying and planning for new climate policies. In addition, all local jurisdictions have adopted an Ozone Advance Plan that aims to improve air quality and avoid a "nonattainment" designation for the region.

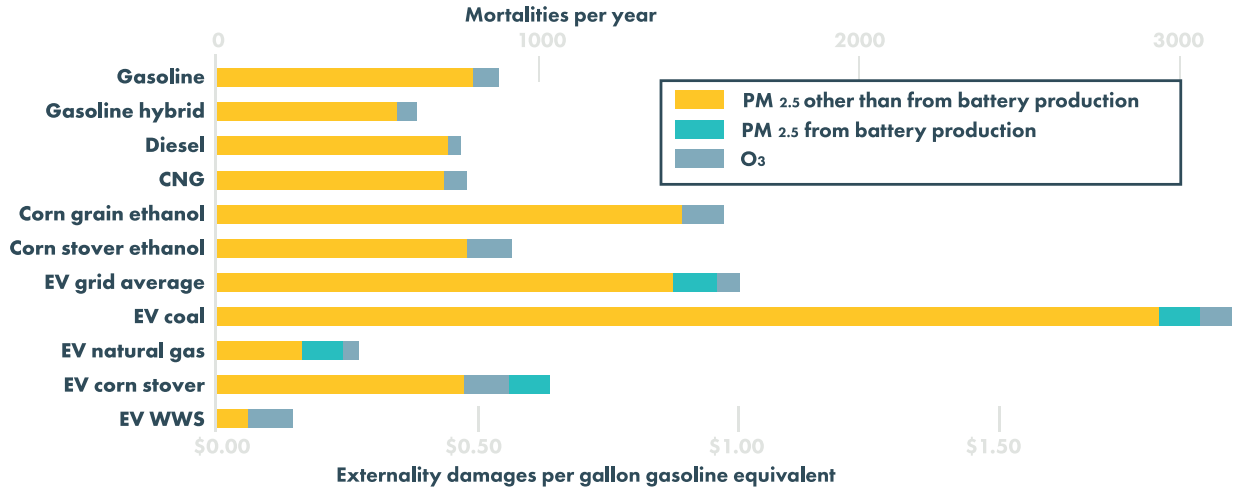
A 2014 study from the University of Minnesota Twin Cities estimated the impacts on air quality if 10

percent of vehicle miles were driven in gasoline-powered, gasoline hybrid, diesel-powered, CNG, ethanol, and electric vehicles.[38] Air quality impacts were measured in well-to-wheel emissions of fine particulate matter (PM2.5) and ground-level ozone (O3). The estimated emissions include tailpipe exhaust, electricity production, natural gas compression, and battery production. EV emissions were measured for multiple scenarios using different energy sources, including the projected 2020 U.S. average generation mix of coal, CNG, corn, and wind/water/solar. The study estimated the increase or decrease in mortalities expected for each scenario compared to a baseline of gasoline-powered vehicles.

As shown in **Figure 4**, the gasoline-powered baseline scenario results in 870 deaths per year. Estimates for the EV scenarios ranged from 230 deaths per year using wind/water/solar to 3,200 per year using coal. The gasoline hybrid, natural gas EV, and wind/water/solar EV scenarios showed decreases in air quality-related health impacts of 30, 50, and 70 percent,

respectively. In contrast, the ethanol, U.S. grid average EV, and coal EV scenarios showed increases of 80, 200, and 350 percent, respectively.

Figure 4: Mortalities per Year by Vehicle Type



Source: University of Minnesota Twin Cities, 2014

A 2018 study from the University of Michigan summarized the key environmental impacts of CAVs at various levels of transportation.[39] At the vehicle level, lower-level automation can result in 20 percent fuel savings and reduced emissions through increased efficiency. Full automation can increase this by an additional 5 to 7 percent, or up to 17 percent for fleet vehicles. Increased CAV penetration will lead to increased fuel savings, lower travel times, and reduced emissions. One study found that even a single CAV on the road can dampen stop-and-go traffic patterns and provide up to a 40 percent reduction in total traffic fuel consumption. Connected heavy-duty trucks, which can platoon at decreased headways, could result in drag reductions of up to 15 percent and consequent fuel and emissions savings. The RTC should continue its evaluation of autonomous buses and their benefits to fuel consumption and vehicle emissions.

At the transportation system level, CAVs could increase roadway capacity by 80 percent and reduce fine particulate matter emissions in urban areas by up to 15 percent. Studies show that using shared autonomous vehicles (SAV) could allow for reductions in fleet sizes because of the efficiencies associated with them. This could result in reduced congestion, increased highway capacity, and

lower emissions. Reduced congestion can generally be linked to a reduction in crashes, particularly those associated with stop-and-go traffic, such as rear-ends. Finally, at the urban system level, CAVs could allow for up to a 30 percent reduction in road lighting (if other safety concerns are not present). For example, streetlights could remain off or dimmed to save power and activate only when a CV is approaching. In tandem with widespread deployment of CAVs, this could yield a savings of $1.65 billion per year. CAVs can also reduce parking needs by an average of 67 percent, providing environmental benefits associated with less pavement and fewer spaces influencing mode choice. The RTC may consider planning for less parking (or shared parking) in the future to take advantage of CAV technology and help influence travel decisions. Parking structures and lots can potentially be transformed through adaptive reuse into residential, office, and/or retail spaces.

5.3 Equity & Inclusion

According to a University of Michigan study, at the society level, CAVs will expand mobility for people with unmet travel needs, such as the disability community and senior groups, offering significant equity benefits.[40] It is estimated that this unmet demand is equal to about 14 percent of the current U.S. vehicle miles traveled (VMT), equating to about 295 billion additional VMT. Agencies and governments should work together to develop pilot programs for CAVs that focus on fostering independence and improving mobility for these groups.

According to the Bureau of Transportation Statistics, 40 percent of disabled persons report difficulty accessing needed transportation. The Ruderman Family Foundation estimates that about 11 million medical appointments are missed every year by people with disabilities due to inadequate transportation.[41] Expanding accessible transportation for this community could enable proactive care, reducing health care expenditures by an estimated $19 billion annually. It would also enable new employment opportunities for two million individuals with disabilities.

The U.S. Department of Commerce estimates that 15.5 million workers work in fields that could be affected negatively by increasing adoption of CAVs. Unemployment has economic and social consequences; one mitigation measure is to help workers transition to sectors that will expand with CAV penetration. Job displacement due to the ongoing growth of alternative fuels can be partially mitigated in a similar fashion.

There is a significant cost barrier for consumers, fleet owners, and agencies looking to enter the EV, AFV, and CAV markets. Financial incentives are key to overcome the affordability barrier for ZEVs and to expand the early market. Equity approaches include increased rebates for low- and moderate-income households, incentives for vehicle replacement, and rebates for used ZEVs.[42] To improve access for low-income households, financial incentives can be provided at the point of sale. Funding should also be dedicated to community-led outreach to build trust between governments and communities like low-income families and non-English speakers. It will be critical to assess how mobility is approached by different populations rather than simply assuming private ZEV ownership for all. Agencies may choose to focus on lower-cost options, such as E-bikes, E-scooters, buses, and carshares.

Charging infrastructure can often be viewed by some groups as a symbol of displacement and gentrification, and acceptance is closely linked with equitable vehicle access. Agencies must consult with communities about barriers and mobility needs, then work backwards. Targeted investment in high-pollution areas can demonstrate benefits and increase community support. EV readiness (e.g., pre-wiring for future private charger installations) is critical to reduce costs, and EV-ready building codes are essential to support equitable investment.

Equity is measured both in access to ZEVs and CV technologies and in access to the benefits they

provide. For example, the air quality benefits related to ZEVs will be seen most significantly in areas where they are most widely adopted because localized emissions will likely decline. However, if ZEVs and charging infrastructure are not accessible to historically

disadvantaged populations (e.g., people of color, immigrant communities, rural communities), those communities will be less likely to experience those lower emissions. As a transit provider, the RTC has an opportunity to focus its initial fleet replacement efforts on buses used on routes serving historically disadvantaged populations.

Inclusive ZEV access will maximize the economic benefits of electrification for all. In Portland, Oregon, the local utility (Portland General Electric [PGE]) has partnered with Forth Mobility to help low-income ride-hail drivers secure fair financing for ZEVs.[43] Combined with standard state and federal rebates and PGE's free public charging program, ride-hail drivers can see large savings when choosing a ZEV over a traditional ICE vehicle. The re-entry community, or those coming out of the criminal justice system, and other marginalized groups are opportunities to meet market and economic growth goals. Workforce development should be prioritized; an example is Portland's Clean Energy Fund, which focuses on low-income communities and communities of color and offers job training in growing markets. Education and outreach will be crucial in promoting ZEV adoption in Nevada's rural areas.

As shared mobility and CAVs reshape the nation's transportation framework, there is an opportunity for agencies to address the inequities of America's long-standing approach to transportation. A 2017 brief from the University of California Davis prioritized four equity concerns related to EVs, CAVs, and shared mobility: cost, access, public health, and employment.[44] The brief identifies strategies governments and agencies may consider in addressing these four priority issues, specifically those that stand to benefit low-income, mobility-challenged, and other historically disadvantaged communities. **Table 6** summarizes the recommended strategies in relation to the issue they aim to address.

Table 6: Strategies Toward Promoting Equity

Issue	Strategy
Disadvantaged communities are not strongly engaged in issues of shared mobility and have difficulty affording or accessing infrastructure related to EVs.	• Engage disadvantaged communities in transportation planning. • Evaluate equity goals and policy impacts using the priority issues above. • Support demonstration projects and spread information. • Create support networks assisting in overcoming shared mobility barriers.
Disadvantaged communities face financial, technological, language and cultural barriers to shared mobility.	• Support demonstration projects, such as automated or electric bus pilots. • Develop accessible platforms for households without bank accounts, credit cards, or online payment systems, such as a membership card or mobile application.
Shared mobility is not always the priority in planning.	• Enforce and/or expand High Occupancy Vehicle (HOV) laws to reduce congestion in shared mobility lanes. • Convert mixed-flow lanes on highways and in urban areas to shared mobility lanes. • Analyze how shared mobility and CAVs can more efficiently use road and parking space and how some can be reallocated to multimodal transportation.
Shared mobility may replace transit in some places without accounting for the resulting barriers to disadvantaged communities.	• Reexamine transit routes and subsidies for low-income riders to serve populations more efficiently

Source: North American Council for Freight Efficiency, 2020

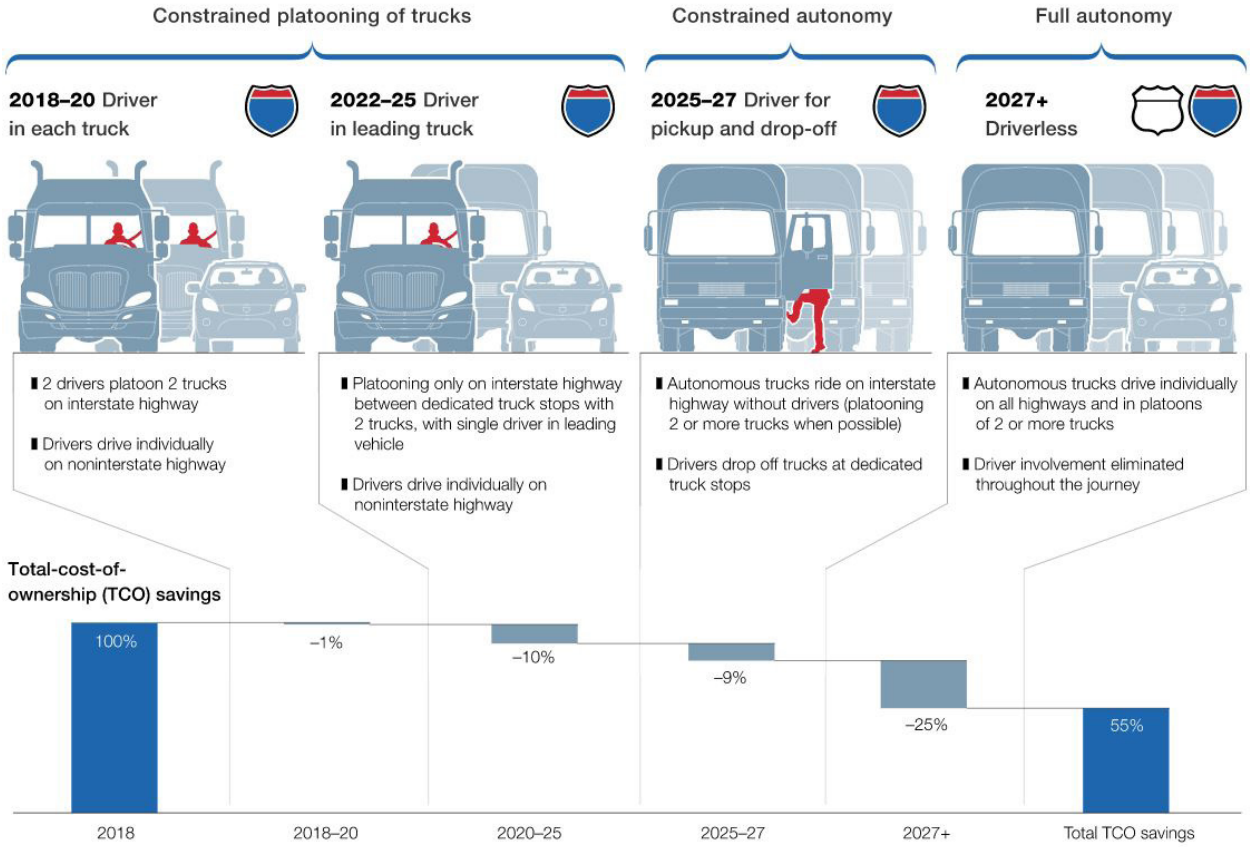
5.4 Freight and Commercial Fleets

Today, 65 percent of America's consumable goods are trucked to market. With full deployment of autonomous trucks (AT), operating costs would decline by about 45 percent, resulting in a savings for the trucking industry of between $85 billion and $125 billion.[45] ATs could also spur consolidation of the national trucking fleet, alleviate the existing capacity crunch, and create opportunities for truck OEMs to enter new markets.

The first two anticipated waves of AT deployment (2018-2025) will introduce "platooning," which allows a convoy of trucks to connect to a lead truck with a driver (**Figure 5**). In the first wave, there will be a driver in each truck; in the second wave, following vehicles will be driverless. Once the vehicles leave the highway, drivers will take control of the truck. Total operating costs per vehicle

will drop by about 10 percent due to fuel and labor cost reductions. In the third wave, "constrained autonomy" will be introduced, where ATs are deployed within "geofenced" areas without platooning. Drivers will take control of the trucks at interstate exits, saving an additional 10 percent of operating costs. In the fourth wave, fully autonomous operations from loading to delivery will begin, resulting in a 45 percent cost reduction.

Figure 5: Phases of Commercial Freight Vehicle Automation



Source: *Route 2030: The fast track to the future of the commercial vehicle industry*, September 2018, McKinsey.com

Source: McKinsey & Company, 2018

In July 2020, 15 states and Washington, D.C. signed a Memorandum of Understanding (MOU) targeting 30 percent of new medium- and heavy-duty truck sales to be ZEVs by 2030 and 100 percent of new sales to be ZEVs by 2050.[46] The State of California has implemented regulations requiring ZEV trucks to account for 5 percent of the trucking market in 2024 and 40 percent in 2032, and an Executive Order states a goal of all medium- and heavy-duty trucks to be ZEVs by 2045. OEMs have accelerated development of medium- and heavy-duty ZEVs, and many will have market-ready vehicles by 2023.

Production costs will need to reduce significantly to make hydrogen economically competitive. However, heavy-duty trucks alone cannot create enough demand to justify scaling up hydrogen (thereby reducing costs). Industrial use of hydrogen must also increase to help create demand before hydrogen fuel prices will decrease—even 30 percent adoption of these technologies in the trucking industry by 2030 would be just 100,000 vehicles per year, compared to 1.8 million freight trailers on U.S. roads today. Current commercial trucks can have lifespans of up to 20 years, so it will likely

take decades to see a meaningful switch to alternative fuels in the industry. The North American Council for Freight Efficiency (NAFCE) notes that hydrogen fuel cell trucks should be considered for duty cycles in cases where:[47]

- Zero emissions at the tailpipe are important.
- Tractor tare weight is critical to maximizing payload.
- Long distance routes over 500 miles are common.
- Winter conditions are significant to operations.
- Green or blue hydrogen is readily available.
- Regions have incentivized hydrogen use.
- Travel is completed in less mountainous regions.

Many of these considerations are applicable to Washoe County, including the presence of long-distance routes (e.g., the I-80 freight corridor) and winter conditions. To support the industry's shift to hydrogen, the RTC should develop partnerships with Washoe County and partner agencies that work to promote the installation of HFC infrastructure.

Finally, the increased potential for autonomous unmanned aerial vehicles (UAV, or drones) to be used in the logistics industry must be considered for potential impacts to the freight industry. A 2019 paper evaluated the feasibility of drone deliveries for last-mile services because UAVs are not likely to be used for long-haul freight but rather individual packages.[48] As such, it is likely that the introduction of drones in logistics would disrupt delivery services like the United Parcel Service (UPS) and mail carriers like the United States Postal Service (USPS) to a larger extent than the nationwide freight industry. This is particularly evident in the scale of deliveries that can be accommodated by each choice because freight vehicles can carry complete loads while drones typically carry one package at a time. With proper planning, UAVs can complement freight activities by providing last-mile services so that freight vehicles can transport larger volumes of goods between their origin and the warehouse.

5.5 Micromobility

Finally, the increasing prevalence of micromobility in urban areas must be accommodated to provide safe travel for all users. Per the International Transport Forum (ITF), micromobility is defined as "personal transportation using devices and vehicles weighing up to 350 kilograms (kg) (770lb) and whose power supply, if any, is gradually reduced and cut off at a given speed limit which is no higher than 45 kilometers per hour (km/h) (28mph)."[49] Type A devices have a maximum mass of 35kg (77 pounds [lb]) and speed not exceeding 25km/h (15.5 miles per hour [mph]). Type B has a higher mass, Type C has a higher speed, and Type D has both a higher mass and higher speed. Type A micromobility, in particular, stands to improve traffic safety by reducing car and motorcycle trips in cities. It can also increase demand for a safe network of bicycle paths and other multimodal infrastructure, in turn spurring those projects. Although E-scooter safety has been noted as a growing concern, it is likely to improve as both users and vehicle drivers become accustomed to micromobility's presence and more safe, supportive infrastructure is installed. The ITF offers the following recommendations to improve the safety of micromobility in cities:

- **Allocate** protected space for micromobility and keep pedestrians safe.

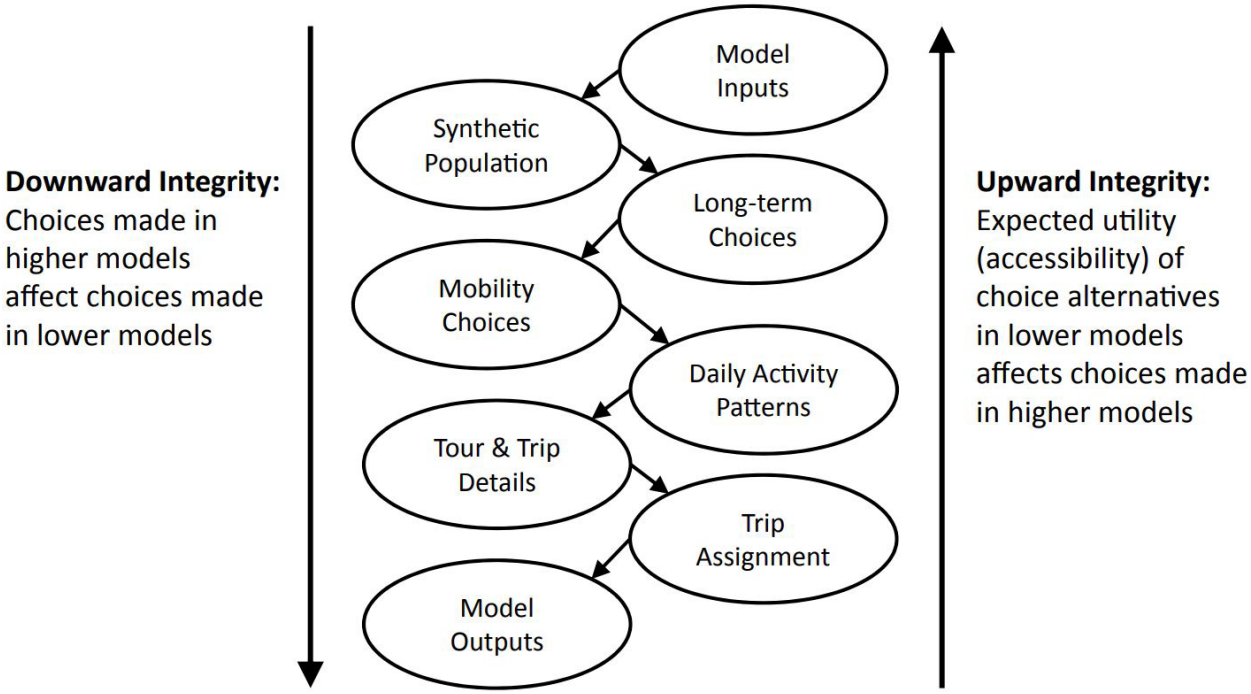
- **Focus** on motor vehicles to increase safety for micromobility users.
- **Regulate** low-speed micro-vehicles as bicycles and higher-speed ones as mopeds.
- **Collect** data on micro-vehicle trips and crashes to fill current gaps in knowledge.
- **Proactively** manage safety performance by prioritizing proactive crash prevention.
- **Include** micromobility in training for car, bus, and truck drivers.
- **Address** impaired driving and speeding for all vehicles by defining and enforcing limits.
- **Eliminate** incentives for micromobility users to speed (e.g., per-minute costs) by reviewing pricing mechanisms.
- **Improve** micro-vehicle design to enhance stability and road grip.
- **Reduce** wider risks associated with micromobility by minimizing van use for rebalancing, using higher-capacity batteries and plug-in docks and allocating on-street "parking."

6 Advanced Mobility in Travel Demand Modeling

While the term "advanced mobility" covers a broad spectrum of travel modes, this section primarily focuses on incorporating CAVs in travel demand modeling because they are expected to have a greater impact on travel behavior than other modes. For example, micromobility (e.g., E- scooters and E-bikes) or rideshare options provided by TNCs are most appropriately addressed in mode choice as another option available to consumers.

The RTC completed the development of an "activity-based" (AB) travel demand model in 2020. Compared with "trip-based" models, AB models have much more detailed input data and generate more detailed output information. AB models are developed as a "disaggregate" as they simulate the travel of each individual person in a household. **Figure 6** shows the main steps and data flow of an AB model system.

Figure 6: Activity-Based Travel Demand Model Data Flow



Source: SHRP 2, Activity Based Travel Demand Models - A Primer

The main components of AB models include synthetic population, where detailed characteristics of every person in a household are created based on observed data from the U.S. Census (e.g., Public Use Microdata Sample files), and long-term choices and daily activity patterns where the models predict activity purposes, locations, timing, and mode. In the RTC's AB model, long-term choice is referred to as "mandatory location choice." This step determines, for example, where a person works or goes to school.

Modeling CAVs explicitly in an AB model will require modifications to the RTC's existing AB model structure. Since there is no observed data for model calibration, changes would be made to the

model framework based on current research about which models would be affected by widespread AV/CV adoption and the extent of those effects. Once observed data are available,

they could be used to calibrate the model parameters that have been incorporated to account for CAVs. Potential changes to the AB model system to incorporate CAVs are illustrated in **Table 7**.

Table 7: Model Changes to Incorporate Connected and Autonomous Vehicles

Model Component	Disaggregate AB Model Improvements
Sociodemographic	
Population Synthesizer	• Control for age and income • Add smartphone ownership and income level
Built Environment	
Urban Form	• Set place type by area type and development type
Mobility	
Vehicle Ownership	• Add CAVs as an option for households to own • Add purchase cost, incentive policies, parking cost, or accessibility variables to distinguish vehicle type
Mobility as a Service	• Add carsharing, ride-hailing, bike sharing memberships
Activity Generation and Scheduling	
Activity Generation	• Lift age restriction for CAVs, add constraint for person with disabilities and seniors using conventional vehicles • Adjust value of time (VOT) and review induced demand • Add representation of empty car trips
Destination/Location Choice	
Work/School Locations	• Integrate with land use model to provide sensitivity
Mode Choice	
Mode Choice	• Add new modes (CAVs, TNCs, shared modes, micro-transit) • Adjust VOT for CAVs • Add dynamic pricing for new modes, adjust parking cost for CAVs • Adjust age and disability requirements for CAVs
Access/Egress	• Add access/egress modes (TNC, shared modes, micro-transit)
Parking Choice	• Add parking choice model to include off-site parking
Pricing	
Cost Model	• Determine cost per mode for each new mode by time period
Parking Costs	• Adjust parking cost as demand shifts away from high-cost areas

Source: NCRHP, Report 896, Guidance 2018

Making structural changes to the AB models to account for AVs and CVs is not a trivial task. While some of the above changes could be accomplished by staff with extensive experience in AB model development, most Metropolitan Planning Organizations (MPO) will require the assistance of consultants to make them. However, until some of the structural changes can be made to the models, there are other approaches to using AB models to account for the impacts of CAVs on travel behavior. These can be characterized primarily as adjustments to model parameters to approximate expected impacts of advanced mobility on the transportation system. For example, two MPOs with AB models conducted scenario planning to evaluate potential impacts of automated vehicles on travel behavior.

Childress et al. tested four adoption scenarios involving partial or full automation:[50]

- **In the first scenario,** they consider expected improvements in traffic operations resulting from automation. They tested a capacity increase of 30 percent on all freeways and major arterials in the travel demand model.
- **In Scenario 2,** they cite existing research that indicates higher-income households are generally the early adopters of technology because of high initial costs. In the travel demand models, they reduced the weighting of auto travel time to 0.65 for high value of time (VOT) trips. In traffic assignment, trip-based VOT was reduced by 65 percent for the highest income households (from $24.00 to $15.60 per hour).
- **In Scenario 3,** they include the above changes but halve parking costs to reflect widespread adoption and full automation. Reduced parking costs reflect the assumption that AVs specifically would self-park in cheaper locations or better utilize existing spaces. It should be noted that this approach would not capture the additional VMT associated with vehicles searching for cheaper parking locations.
- **The final scenario** serves as a counterpoint and assumes that AVs are commonplace and shared AV systems so effective that vehicle ownership is not necessary. Thus, mobility is treated like a public utility and all trips are provided by a taxi-like system at a set rate. Vehicle and road prices are determined by the industry and government to cover operation and maintenance costs. Modeled auto operating costs are increased to $1.65 per mile.

Kim et al. evaluated potential impacts of AVs using the Atlanta Regional Council's AB model.[51] Their methodology involved adjustments to some of the same model parameters as done by the Puget Sound Regional Council (PSRC), which serves the Seattle, Washington, metropolitan area. They reduced the in-vehicle time coefficient for automobiles by 50 percent, increased fuel efficiency in operating costs (a 71 percent reduction in vehicle operating costs), set parking costs at primary destinations to zero, changed generalized costs in highway assignment, and increased roadway capacity by 50 percent.

7 Challenges to Expansion

The challenges faced by any agency in promoting advanced mobility and alternative fuel adoption are unique based on geography, demographics, public opinion, and stakeholder input, among other aspects. As a regional transit operator, the RTC faces unique challenges to incorporating advanced mobility solutions and alternative fuel vehicles in its own fleet, which in turn benefits the broad range of Washoe County residents, visitors, and workers who would have access to those emerging technologies. The specific challenges facing the RTC—and the region as a whole—in relation to achieving identified goals are outlined in Table 8.

Table 8: Challenges to Expansion of Advanced Mobility Solutions and Alternative Fuels

Goal	Challenge
Support electric and alternative fuel vehicle adoption by making charging and alternative fueling sites as accessible and convenient as gasoline fueling stations.	Cost of Installation
	Charging Time
	Access to Chargers/Fueling Sites
	Electrical System Constraints
Promote advanced mobility solutions that benefit the broad range of Washoe County residents, visitors, and workers.	Lack of Policies/Programs
	Access to Vehicles/Services
	Job Displacement
Prioritize equity when planning for the future of transportation in Washoe County.	Equitable Access/Affordability
	Universal Connectivity
	Cultural Sensitivity
Improve awareness of electric, alternative fuel, connected, and autonomous vehicles among individuals and businesses in Washoe County.	Lack of Knowledge/Information
	Resistance to New Technologies
	High Ownership Cost - Real or Perceived
Remove financial and other barriers to adopting emerging technologies for residents, visitors, and workers in Washoe County.	Affordability of Vehicles/Services
	Lack of Knowledge/Information
	Local Sales/Service Network
Provide an industry-leading transportation network that integrates emerging technologies to promote safe and efficient travel in and across Washoe County.	Cost of Infrastructure
	Lack of Industry Standards
	Data Management/Security
Promote the success of regional freight corridors in and through Washoe County by supporting and incorporating emerging technologies in the trucking industry.	Lack of Fueling Infrastructure
	Implementation Cost
	Hydrogen Availability
	Safety Concerns
Identify the impacts of advanced mobility solutions on travel behavior and understand how to integrate them into the planning process.	Lack of Available Data
	Modeling Difficulty

8 Recommendations

The recommendations that will guide the RTC in promoting advanced mobility and alternative fuel adoption should be actionable such that they can be undertaken by the RTC either independently or in coordination with its partner agencies. The following recommendations were developed to satisfy the vision, mission, and goals of this plan, outlined in Chapter 2, and address the challenges identified in Chapter 7.

GOAL 1

Support electric and alternative fuel vehicle adoption by making charging and alternative fueling sites as accessible and convenient as gasoline fueling stations.

Challenge: Cost of Installation

- Identify, maintain, and share information regarding Federal, State and utility rebate and grant opportunities for public EVSE installations.
- Work with member agencies to remove financial "disincentives" to private EVSE installations; for example, by waiving permitting fees and streamlining the permitting process.
- Work with member agencies to develop local incentives for private investment in chargers at workplaces and businesses.

Challenge: Charging Time

- Support efforts to prioritize locations near main travel corridors and at key short stay local destinations for DCFC installations.
- Work with member agencies to identify fast-charging corridors.
- Work with member agencies to incentivize mixed-level charging near residential areas, particularly those with affordable or multi-family housing units, to support overnight and fast charging options.

Challenge: Access to Chargers/Fueling Sites

- Support local efforts to develop a roadmap for EVSE deployment that identifies and prioritizes charging sites.
- Support local efforts to develop an inventory of existing alternative fuel sites (e.g., CNG) for conversion to HFC.
- Support local efforts to develop a plan for conversion to HFC at sites that identifies adoption level triggers for investment to support fleet transitions and interstate commerce.
- Encourage opportunities for shared infrastructure with the public or between fleets or private groups offering mobility services, such as faith-based groups and school districts.
- Encourage EVSE deployment at high-traffic destinations such as parks, airports, community centers, libraries, and ski resorts.

- Install Level 2 EVSE at all RTC park-and-ride facilities.
- Work with local jurisdictions to encourage gas station chains to install DCFC at existing and planned fueling stations through the development approval process or incentives.
- Work with local jurisdictions to encourage truck stops to install HFC charging infrastructure at existing and planned locations.

Challenge: Electrical System Constraints

- Work with the local utility to identify existing locations with three-phase power to support DCFC installation.
- Work with the local utility to promote off-peak charging.
- Identify power requirements for hydrogen production.

GOAL 2

Promote advanced mobility solutions that benefit the broad range of Washoe County residents, visitors, and workers.

Challenge: Lack of Policies/Programs

- Establish a policy that all future RTC fleet vehicle purchases consider ZEVs first.
- Encourage private fleet operators to develop ZEV-first policies for fleet vehicle replacements.
- Establish a ZEV parking minimum of two spaces at all RTC park-and-ride facilities, while considering site-specific criteria (e.g., total number of spaces) and needs for additional ZEV parking.
- Identify opportunities to renovate or replace RTC fleet vehicles to incorporate connected and/or automated technologies consistent with current and future industry best practices.
- Incorporate ZEVs in community and transportation network planning efforts.
- Coordinate with local jurisdictions and local law enforcement to establish and enforce ZEV parking criteria.
- Work with member agencies to develop minimum ZEV parking standards at public parking facilities.
- Work with member agencies to support a code amendment that requires EV-ready infrastructure (e.g., prewiring) in all new construction.

Challenge: Access to Vehicles/Services

- Develop documentation to inform local fleet owners (e.g., faith-based groups, school districts) of the benefits, costs, and financial incentives related to operating ZEV.
- Encourage local educational campuses to establish ZEV carsharing programs for students.
- Implement a single point of purchase system for transit tickets and passes that enables broader and easier access to transit and advanced mobility technologies.
- Collaborate with local agencies to identify "priority zones" where micromobility may be considered as a valid first-/last-mile solution.

Challenge: Job Displacement

- Support local economic development efforts to help workers transition to expanding market sectors related to ZEVs/CAVs.
- Support local vocational schools and community colleges in developing educational materials to support new training courses for ZEV servicing.

GOAL 3

Prioritize equity when planning for the future of transportation in Washoe County.

Challenge: Equitable Access/Affordability

- Identify and share information regarding rebates and programs for low-income ride-hail drivers to secure fair financing for ZEV purchases.
- Equitably distribute advancements in fleet vehicle technologies among the various RTC mobility services.
- Use ZEV and/or connected/automated RTC buses for demonstration programs to introduce communities to new technologies.
- Pursue opportunities to work with key industry members to introduce automated mobility services, particularly for key populations such as senior groups and the disability community.
- Reexamine transit routes as shared mobility grows to apply RTC resources and serve populations more efficiently.
- Encourage member agencies to establish and support workforce development programs that focus on disadvantaged communities to offer job training in growing markets, enable transitions, and grow the local job market.

Challenge: Universal Connectivity

- Work with agency partners to define needs and opportunities for prioritized investment in less densely populated areas to reduce transportation sector impacts related to sprawling growth.
- Develop an inventory of and identify gaps and priorities in fiber communications infrastructure across Washoe County.
- Identify specific advanced mobility applications that would require enhanced communications to inform the gap analysis.
- Identify ownership of existing fiber and develop agreements for shared use.
- Work with partner agencies to develop an interoperable region-wide communications system for shared information.
- Develop a strategic plan for siting EVSE at park-and-rides and commercial businesses with large parking lots in less densely populated areas.

Challenge: Cultural Sensitivity

- Tailor educational materials to meet the needs of the specific populations to be engaged.
- Define 'equity' to guide planning activities and promote fair distribution of the benefits of emerging vehicle technologies.
- Consult with disadvantaged communities about mobility needs and barriers.
- Develop a strategy to work with to community-led outreach organizations to build trust and introduce communities to new technologies.

GOAL 4

Improve awareness of electric, alternative fuel, connected, and autonomous vehicles among individuals and businesses in Washoe County.

Challenge: Lack of Knowledge/Information

- Develop documentation to inform business, education, health, and property management groups on the benefits of private investment in advanced mobility.
- Work with the local utility, advocacy groups, educational centers, and business associates to distribute information to the public.
- Identify and remain up to date on national and other published standards for CAVs.
- Maintain a transit fleet and supporting infrastructure that aligns with current, and scales with future, automation levels.
- Host ZEV/CAV-related information on the RTC website, including links to additional resources.

Challenge: Resistance to New Technologies

- Develop documentation to inform the public on the safety and performance of ZEVs in various environments (e.g., heat, snow).
- Utilize existing industry materials and publications to provide information to the public on the safety of alternative fuels, in particular hydrogen.
- Utilize existing industry materials and publications to provide information to the public on the benefits of micromobility as a first-/last-mile solution.
- Work with non-profit organizations to establish a community-led outreach program focused on the benefits and safety of CAVs.
- Consider cultural sensitivity in all actions promoting unfamiliar technologies.
- Develop a targeted outreach strategy that introduces communities to changes to the driving environment related to advanced mobility technologies, the timeline for changes, and data privacy related to emerging technologies.

Challenge: High Ownership Cost - Real or Perceived

- Utilize existing industry materials and publications to inform the public on the relative low ownership cost of ZEVs.
- Develop documentation to inform the public on home EVSE installation and the relative low cost of home charging.

GOAL 5

Remove financial and other barriers to adopting emerging technologies for residents, visitors, and workers in Washoe County.

Challenge: Affordability of Vehicles/Services

- Identify and share existing educational materials regarding the low life-cycle costs of ZEV ownership.
- Identify and share information regarding Federal, State, and utility rebate opportunities for ZEV purchases.
- Identify and pursue funding opportunities for replacement of RTC fleet vehicles with ZEVs.
- Identify and pursue grant opportunities for purchasing RTC fleet vehicles with connected/automated features.
- Identify and pursue grant opportunities for installing roadside infrastructure to support vehicle connectivity.

Challenge: Lack of Knowledge/Information

- Identify and share information regarding Federal and state tax credits and financial incentives for ZEV purchases.
- Identify and share information regarding local utility rebate opportunities for ZEV purchases.
- Work with member agencies to consider a subsidy program for ZEV purchases by ride-hail drivers.
- Collaborate with local agencies to enable micromobility as a valid first-/last-mile solution in urbanized areas.

Challenge: Local Sales/Service Network

- Develop documentation to inform local service providers of opportunities to enter the ZEV market and the benefits, costs, and financial incentives related to servicing ZEVs.
- Service RTC fleet vehicles locally to encourage and support service providers entering the ZEV market.
- Work with member agencies to consider incentives to support local service providers investing in ZEV training and tools.

GOAL 6

Provide an industry-leading transportation network that integrates emerging technologies to promote safe and efficient travel in and across Washoe County.

Challenge: Cost of Infrastructure

- Identify and apply for Federal and State funding opportunities for purchasing and installing connected vehicle infrastructure.
- Develop industry partnerships to implement cost-shared pilot programs using connected/automated technologies.
- Work with the local utility to identify and apply for EVSE grant opportunities.
- Encourage local jurisdictions to engage property management groups, homeowners' associations, and commercial local businesses to develop and promote financial incentives based on EVSE installation.

Challenge: Lack of Industry Standards

- Identify desired connected vehicle technology applications.
- Identify and prioritize opportunities to install roadside infrastructure to support desired connected vehicle technology applications.
- Prioritize infrastructure in locations and along corridors that best connect communities to each other and to popular destinations.
- Incorporate local government plans and planned development activities in the prioritization process for infrastructure investment.
- Expand successful V2V/V2I/V2X pilot programs to new corridors.
- Utilize incoming connected vehicle and roadway data to evaluate multimodal safety.

Challenge: Data Management/Security

- Define data management processes to account for the data transfer needs of connected vehicles.
- Define security protocols for incoming and outgoing data.

GOAL 7

Promote the success of regional freight corridors in and through Washoe County by supporting and incorporating emerging technologies in the trucking industry.

Challenge: Lack of Fueling Infrastructure

- Work with agency partners to develop a roadmap for HFC deployment that identifies and prioritizes fueling sites.
- Work with agency partners to develop an inventory of existing alternative fuel sites (e.g., CNG) for conversion to HFC.
- Work with agency partners to develop a plan for conversion to HFC at sites that will support fleet transitions and interstate commerce.
- Work with agency partners to prioritize publicly accessible HFC fueling stations along major commercial corridors (e.g., I-80) and near major commercial destinations.

Challenge: Implementation Cost

- Identify and maintain up-to-date lists of grant opportunities for hydrogen fueling station installation.
- Collaborate with freight industry stakeholders to identify an implementation strategy for HFC infrastructure that enables and supports fleet transitions and interstate commerce.
- Conduct a pilot program using HFC RTC buses to measure and prove the efficacy and safety of hydrogen and stimulate HFC use in Washoe County.

Challenge: Hydrogen Availability

- Develop partnerships to obtain an initial hydrogen supply supporting RTC pilot programs.
- Investigate and develop a plan that identifies the RTC's hydrogen demand and storage needs and evaluates opportunities for commercializing excess supply.
- Leverage the future Air Liquide renewable liquid hydrogen plant in Nevada to obtain hydrogen at cheaper rates than outsourcing.

Challenge: Safety Concerns

- Identify and remain up to date on national codes and standards related to the transfer, storage, and use of hydrogen.
- Research, recognize, and define measures to mitigate potential hazards.
- Utilize existing industry materials and work with outside groups as necessary to develop and provide technical training for workers interacting with alternative fuels, such as hydrogen.

GOAL 8

Identify the impacts of advanced mobility solutions on travel behavior and understand how to integrate them into the planning process.

Challenge: Lack of Available Data

- Base updates to the RTC activity-based model on current research on the impacts of CAV adoption in travel demand modeling.
- Incorporate carsharing, bikesharing, ride-hailing, and micromobility in the RTC activity-based model.
- Update the activity-based model as needed to reflect increasing CAV adoption.
- Calibrate the activity-based model as observed data becomes available.
- Coordinate and share modeling best practices related to advanced mobility with local and regional planning organizations to enable a consistent, region-wide approach and bridge knowledge gaps.

Challenge: Modeling Difficulty

- Incorporate available industry guidance as highlighted in Chapter 6, Table 7 of this plan.
- Enlist a consultant to update the activity-based model as needed.

9 Action Plan

This action plan will guide the RTC in successfully implementing the recommendations identified in the previous section. For each recommendation, it identifies:

- **Implementation Lead:** The agency or group leading the implementation effort.
- **Implementation Support:** The agencies and groups supporting the lead.
- **When to Start:** The timeframe during which the RTC should begin implementation—30, 90, 180, or 360 days, or Beyond.
- **Expected Duration:** How long the implementation effort is expected to take—Short, Medium, Long, or Ongoing.
- **Relative Priority:** The relative importance of each recommendation in effecting visible change or preparing for and supporting future efforts—Low, Medium, or High.

The RTC will serve as the lead for each recommendation with support from many agencies and groups to realize the vision and mission of this plan. The partners identified in this action plan are:

The RTC

The RTC should identify a "champion" responsible for tracking and promoting implementation of each identified recommendation. The champion will be an RTC employee with a passion for realizing the vision and mission of this plan by expanding advanced mobility and alternative fuel services in Washoe County. The champion will lead coordination efforts with the local partners in support roles, such as other local transportation agencies, utility providers, fleet operators, and private business owners. Other RTC staff, such as planners and transportation engineers, will support the RTC Champion in promoting advanced mobility and alternative fuel solutions. This staff will identify, maintain, and share information related to these solutions with the public and other stakeholders. They will assist local agencies in implementation efforts, such as identifying communications gaps and needs and prioritizing locations for supporting infrastructure.

Local Agencies

Local transportation agencies will serve in support roles for implementing many of the identified recommendations. For example, the RTC will work with these agencies to support local efforts to prioritize roadside infrastructure, develop plans for HFC conversion, encourage businesses to install EVSE, and consider financial incentives for ZEV purchases. These agencies will also serve as key partners in collecting and distributing information to the public. Coordination between the RTC and these agencies will also promote consistency in implementation of the identified recommendations.

Utility Provider

Nevada Energy is the local utility provider for Washoe County. It will serve a support role in incentivizing EVSE installation, applying for grant opportunities, supporting building code amendments, and completing targeted outreach. It will also assist the RTC in developing documentation and distributing information to the public related to the cost of home installation of EVSE and the low costs associated with home charging.

Industry Businesses

Industry businesses include, but are not limited to, auto dealerships, local service centers, and technical groups. The RTC and these businesses will work together to support local economic and workforce development efforts. The RTC will support these groups by sharing information regarding ZEV/CAV offerings and incentives with dealerships and servicing its alternative fuel and connected fleet vehicles locally.

General Businesses

General businesses include local employers and other groups that can promote and support ZEV/CAV adoption in their businesses. The RTC will support these businesses in installing private EVSE and will provide information that can be distributed to employees to promote adoption within each business's workforce.

Private Operators

Private operators include school districts, businesses, and faith-based groups, among others. Increasing awareness and use of ZEVs and CAVs and other advanced mobility solutions will require all private operator fleets in Washoe County to evaluate and establish plans for fleet vehicle replacements and conversions. The RTC will encourage these transitions and can pursue opportunities for shared infrastructure with these groups to reduce up-front costs and increase utilization.

Local Groups

Many more groups than the ones listed above will be partners in achieving the vision and mission of this plan. Successful implementation of the identified recommendations will require support from educational campuses, outreach groups, law enforcement agencies, property management groups, homeowners' associations, micromobility providers, health groups, and TNCs, among many others.

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Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/ 180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
1 Support electric and alternative fuel vehicle adoption by making charging and alternative fueling sites as accessible and convenient as gasoline fueling stations.	Cost of Installation	Identify, maintain, and share information regarding Federal, State and utility rebate and grant opportunities for public EVSE installations.	L/S							30	Ongoing	High
		Work with member agencies to remove financial "disincentives" to private EVSE installations; for example, by waiving permitting fees and streamlining the permitting process.	L	S						30	Short	High
		Work with member agencies to develop local incentives for private investment in chargers at workplaces and businesses.	L	S			S			90	Medium	Medium
	Charging Time	Support efforts to prioritize locations near main travel corridors and at key short stay local destinations for DCFC installations.	L	S		S	S			30	Ongoing	High
		Work with member agencies to identify fast-charging corridors.	L	S						30	Short	High
		Work with member agencies to incentivize mixed-level charging near residential areas, particularly those with affordable or multi-family housing units, to support overnight and fast charging options.	L	S	S				S	90	Medium	Low
	Access to Chargers/ Fueling Sites	Support local efforts to develop a roadmap for EVSE deployment that identifies and prioritizes charging sites.	L	S						30	Medium	High
		Support local efforts to develop an inventory of existing alternative fuel sites (e.g., CNG) for conversion to HFC.	L	S						30	Short	High
		Support local efforts to develop a plan for conversion to HFC at sites that identifies adoption level triggers for investment to support fleet transitions and interstate commerce.	L	S			S			90	Medium	High
		Encourage opportunities for shared infrastructure with the public or between fleets or private groups offering mobility services, such as faith-based groups and school districts.	L	S	S		S	S	S	90	Long	Medium
		Encourage EVSE deployment at high-traffic destinations such as parks, airports, community centers, libraries, and ski resorts.	L	S	S					30	Ongoing	High
		Install Level 2 EVSE at all RTC park-and-ride facilities.	L		S					180	Medium	Medium
		Work with local jurisdictions to encourage gas station chains to install DCFC at existing and planned fueling stations through the development approval process or incentives.	L	S			S			180	Medium	Low
		Work with local jurisdictions to encourage truck stops to install HFC charging infrastructure at existing and planned locations.	L	S			S			360	Long	Low
	Electrical System Constraints	Work with the local utility to identify existing locations with three-phase power to support DCFC installation.	L		S					30	Short	High
		Work with the local utility to promote off-peak charging.	L		S					30	Short	Medium
		Identify power requirements for hydrogen production.	L		S					30	Short	High

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Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
2 Promote advanced mobility solutions that benefit the broad range of Washoe County residents, visitors, and workers.	Lack of Policies/Programs	Establish a policy that all future RTC fleet vehicle purchases consider ZEVs first.	L/S							Now	Short	High
		Encourage private fleet operators to develop ZEV-first policies for fleet vehicle replacements.	L	S				S		90	Medium	Medium
		Establish a ZEV parking minimum of two spaces at all RTC park-and-ride facilities while considering site-specific criteria (e.g., total number of spaces) and needs for additional ZEV parking.	L/S							30	Short	Medium
		Identify opportunities to renovate or replace RTC fleet vehicles to incorporate connected and/or automated technologies consistent with current and future industry best practices.	L/S							90	Ongoing	High
		Incorporate ZEVs in community and transportation network planning efforts.	L	S						Now	Ongoing	High
		Coordinate with local jurisdictions and local law enforcement to establish and enforce ZEV parking criteria.	L	S					S	90	Short	Medium
		Work with member agencies to develop minimum ZEV parking standards at public parking facilities.	L	S						90	Short	Low
		Work with member agencies to support a code amendment that requires EV-ready infrastructure (e.g., prewiring) in all new construction.	L	S	S					Now	Medium	High
	Access to Vehicles/Services	Develop documentation to inform local fleet owners (e.g., faith-based groups, school districts) of the benefits, costs, and financial incentives related to operating ZEV.	L/S							30	Short	Medium
		Encourage local educational campuses to establish ZEV carsharing programs for students.	L						S	360	Short	Low
		Implement a single point of purchase system for transit tickets and passes that enables broader and easier access to transit and advanced mobility technologies.	L/S							30	Long	High
		Collaborate with local agencies to identify "priority zones" where micromobility may be considered as a valid first-/last-mile solution.	L	S						180	Short	Low
	Job Displacement	Support local economic development efforts to help workers transition to expanding market sectors related to ZEVs/CAVs.	L			S			S	90	Short	Medium
		Support local vocational schools and community colleges in developing educational materials to support new training courses for ZEV servicing.	L			S			S	360	Medium	Low

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Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
3 Prioritize equity when planning for the future of transportation in Washoe County.	Equitable Access/Affordability	Identify and share information regarding rebates and programs for low-income ride-hail drivers to secure fair financing for ZEV purchases.	L			S			S	90	Short	Low
		Equitably distribute advancements in fleet vehicle technologies among the various RTC mobility services.	L/S							Now	Ongoing	High
		Use ZEV and/or connected/automated RTC buses for demonstration programs to introduce communities to new technologies.	L	S					S	Now	Ongoing	Medium
		Pursue opportunities to work with key industry members to introduce automated mobility services, particularly for key populations such as senior groups and the disability community.	L	S					S	180	Long	High
		Reexamine transit routes as shared mobility grows to apply RTC resources and serve populations more efficiently.	L					S		Now	Ongoing	High
		Encourage member agencies to establish and support workforce development programs that focus on disadvantaged communities to offer job training in growing markets, enable transitions, and grow the local job market.	L	S		S			S	360	Long	Low
	Universal Connectivity	Work with agency partners to define needs and opportunities for prioritized investment in less densely populated areas to reduce transportation sector impacts related to sprawling growth.	L	S						30	Short	High
		Develop an inventory of and identify gaps and priorities in fiber communications infrastructure across Washoe County.	L	S						30	Short	High
		Identify specific advanced mobility applications that would require enhanced communications to inform the gap analysis.	L/S							30	Short	High
		Identify ownership of existing fiber and develop agreements for shared use.	L	S						30	Short	Medium
		Work with partner agencies to develop an interoperable region-wide communications system for shared information.	L	S						90	Long	High
		Develop a strategic plan for siting EVSE at park-and-rides and commercial businesses with large parking lots in less densely populated areas.	L				S			90	Medium	Medium
	Cultural Sensitivity	Tailor educational materials to meet the needs of the specific populations to be engaged.	L						S	Now	Ongoing	High
		Define 'equity' to guide planning activities and promote fair distribution of the benefits of emerging vehicle technologies.	L						S	Now	Short	High
		Consult with disadvantaged communities about mobility needs and barriers.	L						S	Now	Ongoing	High
		Develop a strategy to work with to community-led outreach organizations to build trust and introduce communities to new technologies.	L						S	30	Medium	Medium

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Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
4 Improve awareness of electric, alternative fuel, connected, and autonomous vehicles among individuals and businesses in Washoe County.	Lack of Knowledge/ Information	Develop documentation to inform business, education, health, and property management groups on the benefits of private investment in advanced mobility.	L						S	30	Short	Medium
		Work with the local utility, advocacy groups, educational centers, and business associates to distribute information to the public.	L		S		S		S	90	Ongoing	High
		Identify and remain up to date on national and other published standards for CAVs.	L/S							30	Ongoing	High
		Maintain a transit fleet and supporting infrastructure that aligns with current, and scales with future, automation levels.	L	S						Now	Ongoing	High
		Host ZEV/CAV-related information on the RTC website, including links to additional resources.	L/S							Now	Short	Medium
	Resistance to New Technologies	Develop a pro forma to inform the public on the safety and performance of ZEVs in various environments (e.g., heat, snow).	L/S							90	Short	Low
		Utilize existing industry materials and publications to provide information to the public on the safety of alternative fuels, in particular hydrogen.	L				S			90	Short	Medium
		Utilize existing industry materials and publications to provide information to the public on the benefits of personal investment in micromobility as a first-/last-mile solution.	L	S						180	Short	Low
		Work with non-profit organizations to establish a community-led outreach program focused on the benefits and safety of CAVs.	L						S	180	Medium	Low
		Consider cultural sensitivity in all actions promoting unfamiliar technologies.	L						S	Now	Ongoing	High
		Develop a targeted outreach strategy that introduces communities to changes to the driving environment related to advanced mobility technologies, the timeline for changes, and data privacy related to emerging technologies.	L		S				S	90	Medium	High
	High Ownership Cost - Real or Perceived	Utilize existing industry materials and publications to inform the public on the relative low ownership cost of ZEVs.	L/S							30	Short	Medium
		Develop documentation to inform the public on home EVSE installation and the relative low cost of home charging.	L		S					30	Short	Medium

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Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
5 Remove financial and other barriers to adopting emerging technologies for residents, visitors, and workers in Washoe County.	Affordability of Vehicles/Services	Identify and share existing educational materials regarding the low life-cycle costs of ZEV ownership.	L/S							30	Short	Medium
		Identify and share information regarding Federal, State, and utility rebate opportunities for ZEV purchases.	L/S							30	Short	High
		Identify and pursue funding opportunities for replacement of RTC fleet vehicles with ZEVs.	L/S							30	Ongoing	High
		Identify and pursue grant opportunities for purchasing RTC fleet vehicles with connected/automated features.	L/S							30	Ongoing	High
		Identify and pursue grant opportunities for installing roadside infrastructure to support vehicle connectivity.	L/S							90	Long	High
	Lack of Knowledge/ Information	Identify and share information regarding Federal and state tax credits and financial incentives for ZEV purchases.	L/S							30	Short	High
		Identify and share information regarding local utility rebate opportunities for ZEV purchases.	L	S	S					30	Short	High
		Work with member agencies to consider a subsidy program for ZEV purchases by ride-hail drivers.	L	S				S		180	Medium	Low
		Collaborate with local agencies to enable micromobility as a valid first-/last-mile solution in urbanized areas.	L	S						180	Medium	Low
	Local Sales/Service Network	Develop documentation to inform local service providers of opportunities to enter the ZEV market and the benefits, costs, and financial incentives related to servicing ZEVs.	L			S				90	Short	Medium
		Service RTC fleet vehicles locally to encourage and support service providers entering the ZEV market.	L			S				Now	Ongoing	High
		Work with member agencies to consider incentives to support local service providers investing in ZEV training and tools.	L	S						90	Medium	Medium

WASHOE RTC ACTION PLAN

Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/ 180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
6 Provide an industry-leading transportation network that integrates emerging technologies to promote safe and efficient travel in and across Washoe County.	Cost of Infrastructure	Identify and apply for Federal and State funding opportunities for purchasing and installing connected vehicle infrastructure.	L/S							30	Short	High
		Develop industry partnerships to implement cost-shared pilot programs using connected/automated technologies.	L/S							180	Long	Low
		Work with the local utility to identify and apply for EVSE grant opportunities.	L		S					30	Short	High
		Encourage local jurisdictions to engage property management groups, homeowners' associations, and commercial local businesses to develop and promote financial incentives based on EVSE installation.	L				S		S	90	Medium	Medium
	Lack of Industry Standards	Identify desired connected vehicle technology applications.	L/S							Now	Short	High
		Identify and prioritize opportunities to install roadside infrastructure to support desired connected vehicle technology applications.	L	S						30	Medium	High
		Prioritize infrastructure in locations and along corridors that best connect communities to each other and to popular destinations.	L	S						30	Medium	High
		Incorporate local government plans and planned development activities in the prioritization process for infrastructure investment.	L	S						30	Ongoing	High
		Expand successful V2V/V2I/V2X pilot programs to new corridors.	L/S							180	Long	Medium
		Utilize incoming connected vehicle and roadway data to evaluate multimodal safety.	L/S							Now	Ongoing	Low
	Data Management /Security	Define data management processes to account for the data transfer needs of connected vehicles.	L/S							180	Short	Medium
		Define security protocols for incoming and outgoing data.	L/S							180	Short	Medium

WASHOE RTC ACTION PLAN

Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/ 180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
7 Promote the success of regional freight corridors in and through Washoe County by supporting and incoporating emerging technologies in the trucking industry.	Lack of Fueling Infrastructure	Work with agency partners to develop a roadmap for HFC deployment that identifies and prioritizes fueling sites.	L	S						90	Medium	High
		Work with agency partners to develop an inventory of existing alternative fuel sites (e.g., CNG) for conversion to HFC.	L	S						30	Short	High
		Work with agency partners to develop a plan for conversion to HFC at sites that will support fleet transitions and interstate commerce.	L	S			S			90	Medium	Medium
		Work with agency partners to prioritize publicly accessible HFC fueling stations along major commercial corridors (e.g., I-80) and near major commercial destinations.	L	S			S			90	Long	High
	Implementation Cost	Identify and maintain up-to-date lists of grant opportunities for hydrogen fueling station installation.	L/S							30	Ongoing	High
		Collaborate with freight industry stakeholders to identify an implementation strategy for HFC infrastructure that enables and supports fleet transitions and interstate commerce.	L					S		360	Long	Medium
		Conduct a pilot program using HFC RTC buses to measure and prove the efficacy and safety of hydrogen and stimulate HFC use in Washoe County.	L	S						180	Medium	Medium
	Hydrogen Availability	Develop partnerships to obtain an initial hydrogen supply supporting RTC pilot programs.	L/S							Now	Medium	High
		Investigate and develop a plan that identifies the RTC's hydrogen demand and storage needs and evaluates opportunities for commercializing excess supply.	L/S							Now	Medium	High
		Leverage the future Air Liquide renewable liquid hydrogen plant in Nevada to obtain hydrogen at cheaper rates than outsourcing.	L	S						Beyond	Long	Low
	Safety Concerns	Identify and remain up to date on national codes and standards related to the transfer, storage, and use of hydrogen.	L/S							30	Ongoing	High
		Research, recognize, and define measures to mitigate potential hazards.	L/S							90	Medium	High
		Utilize existing industry materials and work with industry groups as necessary to develop and provide technical training for workers interacting with alternative fuels, such as hydrogen.	L			S				180	Medium	Medium

WASHOE RTC ACTION PLAN

Goal	Challenge	Recommendation	Implementation Lead (L) and Support (S)							Start (Now, 30/90/ 180/360 days or Beyond)	Duration (Short, Medium, Long, Ongoing)	Priority (Low, Medium, High)
			RTC	Agencies	Utility	Industry Bus.	General Bus.	Private Operators	Local Groups			
8 Identify the impacts of advanced mobility solutions on travel behavior and understand how to integrate them into the planning process.	Lack of Available Data	Base updates to the RTC activity-based model on current research on the impacts of CAV adoption in travel demand modeling.	L	S						180	Medium	Medium
		Incorporate carsharing, bikesharing, ride-hailing, and micromobility in the RTC activity-based model.	L	S						90	Medium	High
		Update the activity-based model as needed to reflect increasing CAV adoption.	L	S						Beyond	Ongoing	Medium
		Calibrate the activity-based model as observed data becomes available.	L	S						Beyond	Ongoing	Medium
		Coordinate and share modeling best practices related to advanced mobility with local and regional planning organizations to enable a consistent, region-wide approach and bridge knowledge gaps.	L	S						90	Long	Medium
	Modeling Difficulty	Incorporate available industry guidance as highlighted in Chapter 6, Table 7 of this plan.	L/S							90	Medium	High
		Enlist a consultant to update the activity-based model as needed.	L/S							90	Ongoing	Low

Acronyms and Abbreviations

AB	activity-based
AT	autonomous truck
AV	automated vehicle
BEB	battery electric bus
BEV	battery electric vehicle
BMP	Beneficiary Mitigation Plan
CAA	Clean Air Act of 1975
CAV	connected automated vehicle
CNG	compressed natural gas
CO	carbon monoxide
CV	connected vehicle
DCFC	Direct Current Fast Charge
DGE	diesel gallon equivalent
DOE	United States Department of Energy
DSRC	Dedicated Short-Range Communication
EDACS	Enhanced Digital Access Communication System
EV	electric vehicle
EVID	Electric Vehicle Infrastructure Demonstration
EVSE	electric vehicle supply equipment
FCC	Federal Communications Commission
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GHG	greenhouse gas
GLOSA	Green Light Optimized Speed Advisory
HEV	hybrid electric vehicle
HFC	hydrogen fuel cell
HFCEV	hydrogen fuel cell electric vehicle
ICE	internal combustion engine
ITS	Intelligent Transportation System
kg	kilogram
km/h	kilometers per hour
lb	pound
LDV	light-duty vehicle
LEV	low-emission vehicle

LiDAR	light detection and ranging
LNG	liquefied natural gas
LPG	propane
MDV	medium-duty vehicle
mph	miles per hour
MPO	Metropolitan Planning Organizations
NAFCE	North American Council for Freight Efficiency
NCAR	National Center for Atmospheric Research
NDEP	Nevada Department of Environmental Protection
NDOT	Nevada Department of Transportation
NEH	Nevada Electric Highway
NHTSA	National Highway Traffic Safety Administration
NOx	nitrogen oxide
NVE	Nevada Energy
O3	ground-level ozone
OEM	Original Equipment Manufacturer
PHEV	plug-in hybrid electric vehicle
PM2.5	fine particulate matter
RFID	radio frequency identification
RNG	renewable natural gas
ROC	Road Operations Center
RRFB	Rectangular Rapid Flashing Beacon
RTC	Regional Transportation Commission
RWIS	Road Weather Information System
SAV	shared autonomous vehicle
TIGGER	Transit Investment for Greenhouse Gas and Energy Reduction
TNC	transportation network company
U.S.	United States
UNR	University of Nevada Reno
USDOT	U.S. Department of Transportation
V2I	vehicle-to-infrastructure
V2V	vehicle-to-vehicle
V2X	vehicle-to-everything
VMT	vehicle miles traveled
WCSD	Washoe County School District
ZEV	zero-emission vehicle

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