COLORADO Department of Transportation   COLORADO Energy Office

Sens. Winter, Bridges, Moreno and Priola, Reps. Hansen and Gray, Bird, Buentello, Cutter, Duran, Hooton, Michaelson Jenet, Valdez, A.:

In May of this year, through S.B. 19-239, you tasked the Colorado Department of Transportation to study and consider addressing the impact of transportation changes. This mandate comes at a time of many converging trends that impact our transportation system. Colorado is facing rapid population growth over the next 30 years, and our transportation infrastructure is aging without the means to repair it quickly enough. Our transportation funding is insufficient and outdated. The fuel tax, which in Colorado as elsewhere is the primary mechanism to pay for transportation, and inflation erodes the purchasing power of those dollars, while the mechanism, unchanged for decades, does not capture the impacts to our system of new technologies ranging from ridesharing to electric vehicles. Moreover, the changing nature of today's economy puts new pressures on our system.

The six transportation providers identified in S.B. 19-239, transportation network companies (TNC), car share companies, taxi companies, car rental companies, and delivery services, are expected to grow significantly as a portion of vehicle miles travelled (VMT) by 2030. The new services and business models identified are only the beginning, as autonomous vehicles and other, unimagined, transportation technologies continue to evolve and impact our system. All of these trends impact the condition of existing roads, and influence levels of traffic, local air pollutants and greenhouse gas emissions.

In order to better understand these new business models and identify ways in which the State can help address some of these impacts, you asked us to convene a broad and diverse set of stakeholders to provide input on future policies. This included all of the relevant industry players, including Uber, Lyft, Amazon, the Colorado Motor Carriers Association, and advocacy and government representatives, such as the Southwest Energy Efficiency Project, the Denver Regional Council of Governments and many more. Over the course of six months, the stakeholders met and discussed the issues identified in the legislation, and we are deeply appreciative of the time and energy that participants committed to this process. Of course, with such a divergent set of interests, there were many areas of differing perspectives and goals among the group.

The group examined the impacts and forecasted growth of each of the industries identified, both in terms of congestion and climate/air quality impacts. The Colorado Energy Office was a critical co-chair in this effort, helping to tie together transportation interests with the State's priorities around climate and air quality goals. As requested in the legislation, the stakeholders also considered a range of fee structures (i.e., mileage-based, percent of transaction, or flat fees) and possible rates of fees that could be collected, and how these could be structured to incentivize shared trips and zero-emission vehicle (ZEV) adoption. In order to study all of these issues in more detail, the stakeholders formed subcommittees to delve into specifics on ZEV adoption, safety, emissions, shared ridership, social equity, and fee structures.

There were many relevant takeaways from the discussion that will inform our discussion with you in the next legislative session.

- **Existing Fees:** Fee structures should consider all of the types of fees that emerging mobility providers are already contributing to offset their impacts to transportation infrastructure. As you will see in the full report, many of these providers pay varying levels of fees to the State and localities in Colorado.

- **Ease of Implementation:** Generally, the Working Group concurred that a flat or percent of transaction fee would be easier for companies to implement in the near term because these types of fees are already administered by other cities, airports, and states.

- **Alignment with S.B. 19-239 Goals:** In contrast, the Working Group generally concurred that a mileage-based fee would more readily meet the requirements of SB 19-239. However, this fee would be more difficult to implement and would require new development by the companies.

- **Graduated Fees:** The Working Group agreed that shared and ZEV rides should be discounted; while it was generally agreed that a shared and ZEV ride should have the lowest or no fee, there was disagreement about the level of discount for a shared ICE vehicle or a single-passenger ZEV.

- **Flexibility:** The Working Group expressed interest in flexibility in the fee structure to change over time, both to reflect policy changes as well as new business models in transportation. It was also recognized that it may make sense to implement easier approaches, such as flat fees or percentage fees, in the early days, while preserving an ability to transition to mileage-based fees as it becomes more technically feasible. This could include the creation of an Advisory Committee to continue discussion of these new technologies and their impacts on the transportation system, as well as an ability to modify the fee through an administrative process.

- **Data:** We appreciated industry participation in this process, and their feedback was critical. However, there is a lack of data about emerging mobility providers, and without the tools to properly handle proprietary information, it was difficult to assess the true impacts of these services. Future legislation should include data collection authority by the regulatory body that will help inform the effectiveness of any fees and policies.

Based on initial forecasting and modeling, implementing a fee on emerging mobility providers aligned with those seen in other jurisdictions could generate annual statewide revenue between $14 and $80 million. Of course, we know that our transportation funding gap is much wider than this, and that emerging mobility is only a small (but growing) segment of VMT. To that end, it is important that we develop a new and broader structure to pay for use of our roads, and one which will increasingly account for the ever diversifying user base. In addition, we must ensure that the revenues collected from these services aid in achieving our goals to support ZEV adoption and shared trips to reduce congestion.

We look forward to continuing this conversation with you over the coming months.

Shoshana M Lew

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2019 EMERGING MOBILITY IMPACT STUDY

Report on Colorado Senate Bill 19-239

COLORADO
Department of Transportation

COLORADO
Energy Office

Prepared by staff from the Colorado Department of Transportation and the Colorado Energy Office, based on feedback from the SB 19-239 Working Group

November 2019

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ABBREVIATIONS AND ACRONYMS

CDOT	Colorado Department of Transportation
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
EV	electric vehicle
FAC	Colorado Freight Advisory Council
FHWA	Federal Highway Administration
GVWR	gross vehicle weight rating
HB	House Bill
ICE	internal combustion engine
MOVES	Motor Vehicle Emissions Simulator
NHTS	National Household Travel Survey
PUC	Public Utilities Commission
SB 19-239	Colorado State Legislature Senate Bill 19-239
SB	Senate Bill
TNC	Transportation Network Company
USDOT	United States Department of Transportation
UPS	United Parcel Service
USPS	United States Postal Service
VMT	vehicle miles traveled
ZEV	zero-emission vehicle

EXECUTIVE SUMMARY

Colorado's population and economic growth within the current land use patterns and transportation networks are leading to more trips and more vehicle miles traveled (VMT) on already crowded Colorado roadways. Traffic congestion has a negative impact on the economy and the environment. Vehicles are the second largest source of greenhouse gas emissions and one of the two main contributors to ozone pollution, and growth in VMT leads to increased emissions. Emerging technology offers opportunities to travelers who are seeking alternative modes to make their trips, and it provides consumers the option of e-commerce real-time package delivery. Use of these new mobility and delivery platforms continues to expand in volume leading to increased VMT, which continues to impact the transportation network. The technology is also anticipated to be used by transportation providers operating connected and autonomous vehicles.

Colorado cannot continue to build its way out of congestion, and the rise in VMT contributes to the worsening air quality problem. Therefore, the State of Colorado must develop methods to manage and reduce overall transportation demand on the transportation network, and to encourage a shift from polluting gasoline and diesel vehicles to zero emission vehicles (ZEV), such as electric vehicles (EV). Secondly, the State must provide incentives to convert trips made in internal combustion engine (ICE) vehicles into trips using ZEVs. Thirdly, the State must slow the growth in VMT by incentivizing pooled ridership in which more than one passenger shares a vehicle for a trip.

To help address these issues, the Colorado State Legislature passed Senate Bill (SB) 19-239, which directed the Colorado Department of Transportation (CDOT) to convene a group of appointed stakeholders (the Working Group), conduct a study, and solicit policy recommendations. The Working Group was charged with evaluating impacts of the emerging mobility providers and providing feedback on a range of potential fee structures on motor vehicles used for commercial purposes, as defined by SB 19-239, that could be used to encourage use of ZEVs and shared rides in emerging mobility providers to more efficiently utilize Colorado's transportation system and to incentivize a transition to ZEVs.

The Working Group, with technical support from CDOT, the Colorado Energy Office, Colorado State University, and a consultant team, conducted the study and developed recommendations within an expedited timeline of six months, from June 2019 to November 2019. CDOT enabled the production of this report.

The Working Group and associated subcommittees assessed issues and studied alternatives. The process included a literature review, modeling analysis, and agency coordination. The technical analysis of alternatives was conducted using travel demand modeling, economic forecasting, and geospatial visualization. This Working Group coordinated with relevant agencies and providers regarding the findings presented in this report, the impacts of its recommendations, and the development of methods and procedures to implement the recommendations.

CDOT will consider the results of the study and Working Group input in developing policy recommendations to guide the Colorado State Legislature for action during the 2020 Legislative Session. CDOT will present findings from the Working Group to the General Assembly's 2019 State Measurement for Accountable, Responsive, and Transparent Government Act hearing in January 2020. CDOT will also be responsible for providing a final written report to the Transportation Legislation Review Committee during the 2020 legislative interim.

Modeling Results

Emerging mobility providers (as defined by SB 19-239 to include taxis, rental cars, peer-to-peer car share, non-peer car share, transportation network companies, and commercial vehicles used for e-commerce and residential delivery) produced approximately 4.5 million VMT per day in Colorado in 2018—somewhere between 2% and 8% of the state's VMT. However, the 4.5 million VMT estimate underscores the uncertainty in estimating VMT for these providers due to limited available data and the short timeframe in producing estimates. Nevertheless, by 2030, the total VMT of these emerging mobility providers is expected to grow 140% to approximately 11 million (with an estimated range between 5 million and 28 million VMT per day). Therefore, by 2030, these emerging mobility providers could represent 7% of the state's total VMT (with an estimated range between 3% and 17%).

Using best estimates for VMT, in 2018, greenhouse gas emissions pollution associated with emerging mobility providers is approximately 2,000 short tons of carbon dioxide equivalents (CO_2e) per day. Despite expected improvements in vehicle efficiency, these providers are expected to produce 50% more carbon emissions in 2030 (approximately 3,100 short tons of CO_2e per day).

Using these baseline estimates for current and future travel associated with emerging mobility providers, the impacts of various fee structures were analyzed. Three fee structures (mileage-based, flat, and percentage-based) were applied in a low-impact scenario (i.e., low fees and assuming less behavioral response) and a high impact scenario (i.e., high fees and assuming more behavioral response). The results show that fee structures within the tested range would reduce VMT associated with emerging mobility providers by between 1% and 4% in 2030, and would generate annual statewide revenue between $14 million and $80 million. Within these ranges, there is room to design policy options that can account for potential costs and benefits to providers, consumers, infrastructure investment, and the environment.

Working Group Recommendations

Given the diverse interests among the stakeholders, no consensus was reached regarding a specific fee structure; however, several recommendations were identified. The Working Group's policy recommendations are intended to (1) efficiently manage the transportation demand for Colorado residents, businesses, and tourists; (2) minimize the impacts of carbon-fueled vehicles; (3) increase the number of electric vehicles; and (4) reduce the number of single-occupancy trips, while increasing ridesharing. These recommendations are the result of an examination of system impacts of new and emerging transportation technologies and business models. Further, the recommendations include the means of addressing the system impacts, potentially with funding from the imposition of fees on the use of a motor vehicle used for commercial purposes.

Recommendations included general principles, such as accounting for social equity, demographic changes, and the positive impacts of emerging mobility technologies, including expanded transportation options and economic development when considering a fee structure. In addition, the existing fees on such providers were raised as significant considerations.

Efforts to specifically address the intent of SB 19-239 included emphasis on first-and last-mile rides to transit stops, as well as complementing existing efforts to support ZEV adoption among emerging mobility providers, and congestion pricing to address peak times. All of these proposals were aligned with the goals of reducing single-occupancy rides and encouraging adoption of ZEVs.

Of course, as fee structures get more complicated, they are more difficult to implement. An overarching comment from the Working Group was that ease of implementation is an important component. Generally, the Working Group concurred that a flat fee would be easier for companies to implement because flat fees are already administered by other cities, airports, and states. In contrast, the Working Group generally concurred that a mileage-based fee would more readily meet the requirements of SB 19-239. However, this fee would be more difficult to implement and would require new development by the companies. In addition, the Working Group generally agreed that any fee should discount shared and ZEV rides.

Finally, the Working Group expressed interest in flexibility in the fee structure to change over time, to reflect evolving business models and new technologies, such as autonomous vehicles. It was also recognized that it may make sense to implement easier approaches, such as flat fees or percentage fees, in the early days, while preserving an ability to transition to mileage-based fees as it becomes more technically feasible.

CHAPTER 1. STUDY BACKGROUND

1.1 Introduction

This study is a compilation of findings and recommendations required under Senate Bill 19-239: Address Impacts of Transportation Changes.[1] This legislation requires CDOT to examine "the impacts of technological and business model changes related to commercial vehicles, and…convene and consult with a stakeholder group to examine impacts of new transportation technologies and business models, identify means of addressing impacts and report findings, and make recommendations to the General Assembly." The full text of the law can be found in Appendix A.

The Working Group and its subcommittees prepared this report with recommendations for CDOT to make to the General Assembly.

This report documents the first phase of findings from stakeholders that will inform CDOT's presentation to the General Assembly during the 2020 legislative session.

1.1.1. Growth of Emerging Transportation Commercial Providers and Limitations of Colorado Transportation Network

Colorado's transportation system faces growing pressure due to continued population and economic growth, and land use patterns that create large distances between jobs and housing. In August of 2018, the Colorado State Demographer's Office reported that Colorado's population increased by nearly 500,000 people between 2010 and 2017. By 2040, the population is expected to be well over 7 million[2]. Colorado also attracts a large number of visitors. The Colorado Office of Tourism reported that there were a record 85.2 million travelers to the state in 2018.[3] Colorado roadways are already crowded, and traffic congestion delay results in over $3.6 billion per year in economic impact to the state in terms of wasted fuel and wasted time, based on one approach to measuring congestion costs.[4]

In addition, the transportation system has emerged as a major source of damaging air pollution. The Denver metro area and North Front Range are currently in violation of federal health-based standards for ozone pollution. The area is currently rated by the U.S. Environmental Protection Agency as a "moderate" violator, but is likely to be bumped to "serious." Source apportionment by the Regional Air Quality Council has determined that there are two major contributors to locally produced ozone. Oil and gas drilling and production activities are our largest source of volatile organic compounds, while motor vehicles are the largest source of nitrogen oxides.[5] When volatile organic compounds and nitrogen oxides mix in the presence of sunlight, ground-level ozone is formed.

In addition, transportation is a major source of the greenhouse gas pollution that is leading to dangerous climate change. Colorado's State Legislature adopted HB 19-1261 in the spring of 2019, which set goals of reducing greenhouse gas emissions 50% below 2005 levels by 2030 and 90% by 2050. Emissions inventories conducted by the Colorado Department of Public Health and Environment Air Pollution Control Division have found that transportation is the second largest source of this pollution, after the electricity sector.[6] Electricity emissions are dropping rapidly as wind and solar are added to the system and replacing old coal plants, but emissions from transportation have been almost flat. Achieving the State's goals will require deep cuts in transportation emissions to account for its overall share of the State's emissions portfolio.

Emerging technologies are placing additional demand on the transportation network. New providers, such as car share, transportation network companies (TNC), and on-demand delivery services build on or disrupt the business models of existing services, such as taxis, car rental, and traditional freight delivery.

Among the major emerging technology providers are car-sharing companies that allow short-term rental of individually owned (peer-to-peer) or fleet-owned (non-peer) vehicles. While the underlying concept dates back several decades, smartphone technology, easy access to the internet, and the ease of digital transactions have created an increase in car-sharing operations. Industry leaders and researchers predict that, by 2025, there could be nearly 10 million participants in peer-to-peer car-sharing services alone.[7]

TNCs represent a significant application of emerging technologies in offering new transportation services. These providers use a digital network to connect riders to drivers for the intention of providing transportation for commercial purposes. TNCs are a disrupting technology, with the potential to completely transform the existing array of mobility options. Forbes Magazine notes that "…. Uber and growing rival Lyft have captured 70.5% of the U.S. business traveler market, according to a recent study by expense management software company Certify. This leaves the rental car industry with 23% of the market, and the taxi industry with 6%. Obviously, this disruption has been bad for stockholders in such leading rental car companies as Hertz and Avis. Hertz's stock price experienced a 22.2% decline in 2018.[8]

In addition, e-commerce real-time package delivery has a growing impact. In 2018, the online retail sales in the United States reached USD $517.4 billion according to the "Digital Commerce 360's" website.[9] Similarly, e-commerce companies like Amazon Flex (an Amazon delivery program that hires independent drivers to complete various types of deliveries) and UberEats (a division of Uber that hires independent drivers to deliver food from selected restaurants on-demand to customers) will allow for virtually any motivated driver and vehicle to become an on-demand package or meal delivery service. Use of these new mobility and delivery platforms continues to expand in volume and VMT. The technology is also anticipated to evolve into electric, shared, connected, and autonomous vehicles.

One of the tasks of this study is to measure and evaluate the impacts of emerging technology providers to mobility statewide. Traffic modelers and transportation planners are forecasting a sizeable impact of the potential additional VMT on the transportation network due to TNC trips to both pick up and deliver passengers and parcels. A TNC study completed by Alejandro Henao of the University of Colorado found that for every 100 passenger VMT, there was an additional 69 miles of VMT without a passenger in the vehicle.[10] These additional miles to pick up a passenger or to drive home at the end of a shift are known as "dead-heading."

Colorado cannot continue to build its way out of congestion. Transportation funding is limited, there is a public health and climate imperative to reduce emissions, and the impacts of these emerging services can potentially add additional stress on our roadways. Tools identified in this study may offer solutions to help mitigate those impacts.

1.1.2. Transitioning to Zero Emission Vehicles

Colorado faces serious air quality issues and impacts from climate change. According to the U.S. Environmental Protection Agency, the transportation sector is one of the largest contributors to U.S. greenhouse gas emissions (a major contributor to overall air pollution). In response to these challenges, Governor Jared Polis has laid out a number of initiatives to address pollution, air quality, and greenhouse gas emissions from the transportation sector. Lowering vehicle emissions by reducing VMT, increasing shared rides, and shifting more trips from vehicles with internal combustion engines (ICE) to ZEVs will help reduce carbon emissions.

Types of Zero Emission Vehicles

- Battery Electric Vehicles (BEV)
- Plug In Hybrid Electric Vehicles (PHEV)
- Renewable Natural Gas Vehicles (RNG)
- Hydrogen Vehicles

To achieve the goal of 940,000 ZEVs in Colorado by 2030, the Polis Administration has worked with the Colorado State Legislature to move forward a number of initiatives to encourage electrification across the transportation sector. In addition to this study, Colorado statewide efforts include:

- **The Air Quality Control Commission adopted the ZEV standard**, providing more options for electric vehicle purchases across the State. As of August 2019, there were at least 48 ZEV models on the market. Adopting the ZEV standard will help incentivize manufacturers to make these models available at Colorado dealers.[11]
- **The State awarded a $10.3 million grant to partner with a private company** to build fast-charging stations across the state in accordance with the Colorado Electric Vehicle Plan. The fast-charging stations will be located along interstate, state, and U.S. highways across the state.[12]

A Working Group meeting to discuss potential recommendations for this report.

- **The Colorado Department of Health and Environment revised Colorado's Beneficiary Mitigation Plan for the Volkswagen Diesel Emissions Settlement Funds** to support greater electrification efforts, including more funding for transit fleet and medium and heavy-duty vehicle fleet electrification.[13]
- **The State Legislature passed SB19-077: Public Utility Implementation of an Electric Vehicle Infrastructure Program which** authorizes public utilities to provide charging stations and requires utilities to file applications to support widespread transportation electrification, and EV specific rate offerings.[14]
- **The State Legislature passed HB19-1159: Modifications to the Income Tax Credits for Innovative Motor Vehicles which** modifies the amounts and extends the number of years of existing state

income tax credits for the purchase or lease of electric or hydrogen fuel cell vehicles. Allows ride-sharing companies to claim the full tax credit if vehicles are provided to drivers under a short-term rental program.[15]

- **The State Legislature passed HB19-1198: Power and Duties of the Electric Vehicle Grant Fund** which **pr**ovides more flexibility in how the Electric Vehicle Grant Fund is used by allowing funds for administration of charging station grants and to offset charging station operating costs.[16]
- **The State Legislature passed HB19-1261: Climate Action Plan to Reduce Pollution** which sets statewide goals to reduce 2025 greenhouse gas emissions by at least 26%, 2030 greenhouse gas emissions by at least 50%, and 2050 greenhouse gas emissions by at least 90% of the levels of statewide greenhouse gas emissions that existed in 2005. [17]
- **The Public Utility Commission (PUC) Proceeding 18AL-0852E** advocates for electricity rates that support customer investment in charging stations to help expand the development of electric vehicle charging.[18]
- **Governor Polis passed Executive Order B2019-002** on January 17, 2019, which requires CDOT to develop a ZEV and "clean transportation plan" to support the widespread deployment of electric vehicles in ways that save energy, reduce congestion and improve the transportation network**.**

1.1.3. Planning for Emerging Technologies

Public agencies work closely with emerging mobility providers on initiatives to improve transportation service, access, and safety. The central focus of these efforts have been to build upon past and current programs and initiatives to maximize the benefits of both the public transportation options and private services that are becoming an increasing part of the traveling public's range of mobility options. These partnerships include narrowly focused pilot projects, partnerships that engage emerging technology to increase access to transit and ride sharing, studies and regional long-range plans. For example, Uber[19] and Lyft[20] recently partnered with the Regional Transportation District to redesign the TNCs' mobile applications (apps) to provide customers with transit information alongside TNC ride options, including real time information and end-to-end directions.

1.2 The Role of Senate Bill 19-239

SB 19-239, signed by the Governor in May 2019, tasks CDOT with convening the Working Group to explore the impacts and make recommendations about how to reduce them.

1.2.1. Sponsors

Prime Sponsors: Senator Jeff Bridges, Senator Faith Winter, Representative Matt Gray, and Representative Chris Hansen

Co-Sponsors: Senator Dominick Moreno, Senator Kevin Priola, Representative Shannon Bird, Representative Bri Buentello, Representative Lisa Cutter, Representative Monica Duran, Representative Edie Hooton, Representative Dafna Michaelson Jenet, and Representative Alex Valdez

1.2.2. Intent & Purpose

The primary task outlined in SB 19-239 was addressed through a study process led by the Working Group to provide recommendations to CDOT. The study has two primary areas of focus: 1) reducing congestion caused by emerging mobility services and 2) reducing vehicle carbon emissions from emerging mobility services. The Working Group approached this task by examining the economic, environmental, and transportation system impacts of new and emerging transportation technologies and business models. Further, the group identified potential means of identifying ways to ensure that the transportation providers are contributing positively to the state's transportation system; and advanced policy recommendations to meet these goals, potentially with funding from the imposition of fees on the use of a motor vehicle used for commercial purposes. Finally, the Working Group developed recommendations for new fee structures on emerging mobility providers designed to meet the objectives of SB 19-239:

- Generate revenue for state and local governments to mitigate specified impacts to the transportation system.
- Fund needed transportation infrastructure, including multimodal infrastructure and the infrastructure needed to support the adoption of ZEVs.
- Defray the administrative costs of fee collection.
- Incentivize the adoption of ZEVs for utilization as motor vehicles used for commercial purposes.
- Incentivize multiple passenger ride sharing for motor vehicles used for commercial purposes and the use of such vehicles as a first and last mile solution for users of public transit.

1.2.3. Roles & Responsibilities

The roles and responsibilities for the entities involved in responding to Senate Bill 19-239 are presented in Table 1-1.

Table 1-1. Emerging Mobility Impact Study Roles and Responsibilities

Entity	Responsibilities
Colorado State Legislature	Initiate SB 19-239, which was signed by Governor on May 31, 2019. Based upon the study results and Working Group recommendations, may pass legislation during the 2020 session regarding emerging mobility providers.
CDOT-Colorado Department of Transportation	Lead study to support Senate Bill 19-239. Identify members and convene a Working Group with broad interests and representation to study issues outlined in Senate Bill 19-239.
CEO-Colorado Energy Office	Serve as co-chair of Working Group.
Working Group	Attend and prepare for Working Group meetings, and participate in subcommittees that meet separately and report technical information back to the Working Group. Make recommendations to CDOT representing the interests of participating organizations, subcommittees, and the full Working Group.
Subcommittees to the Working Group	Conduct technical analysis and make recommendations in specific topic areas relevant to the Working Group's efforts to respond to tasks outlined in Senate Bill 19-239. The six subcommittees were: Incentivizing Zero Emission Vehicles Natural Environment Impact and Emissions Analysis Congestion Management: Incentivize Shared Ridership Social Impact and Equity Analysis Safety Fee Structure for Emerging Mobility Providers
Freight Advisory Council	As representatives of freight industry stakeholders, provide guidance on policy and planning to CDOT and other organizations and supply information on current and evolving practices related to the residential delivery of goods.

1.2.4. Working Group Membership

Participants in the Working Group were identified based on guidance from SB 19-239. CDOT executive leadership staff invited qualifying individuals via letter, with follow-up phone calls and email contact. The membership organizations are listed in Table 1-2. Numerous additional interested parties representing a range of public and private entities participated at various levels throughout the process. These included, but were not limited to, representatives from the North Front Range Metropolitan Planning Organization, the Colorado Association of State Transit Agencies, the Regional Transportation District, Ford Mobility, and the National Renewable Energy Laboratory.

Table 1-2. Working Group Member Organizations per SB 19-239

SB 19-239 Guidance	Organization
State government employees—*an employee of the department (CDOT) who is not an employee of the High-Performance Transportation Enterprise*	Department of Transportation
State government employees—*an employee of the Colorado Energy Office*	Colorado Energy Office
State government employees—*an employee of the Department of Revenue*	Department of Revenue/ Department of Motor Vehicle
State government employees—*the chief of the Colorado State Patrol or the chief's designee*	Colorado State Patrol
Representatives of state and local governments and transportation planning entities—*representative of a statewide organization that represents the interests of counties*	Adams County
Representatives of state and local governments and transportation planning entities—*representative of a statewide organization that represents the interests of municipalities*	Denver Regional Council of Governments
Representatives of state and local governments and transportation planning entities—*A representative of rural transportation planning organizations*	Southwest Transportation Planning Region
Business representative—*Two representatives of transportation network companies*	Uber
Business representative—*Two representatives of transportation network companies*	Lyft
Business representative—*A representative of a business that has expertise regarding the technology and processes required to develop, implement, and administer a road usage charge program*	KPMG
Business representative—*A representative of certificated taxi carriers*	Freedom Cabs
Business representative—*A representative of a rental car company*	Enterprise
Business representative—*A representative of a business that is a peer-to-peer car sharing program*	Drift
Business representative—*A representative of a car sharing network company that does not use a peer-to-peer car sharing business model*	SHARE NOW (formerly car2go)
Business representative—*A representative of the freight advisory council*	Freight Advisory Council
Business representative—*A representative of the contracting industry that works on or represents businesses that work on transportation infrastructure projects*	Colorado Contractors Association
Business representative—*A representative of the engineering industry*	Iron Stride Solutions

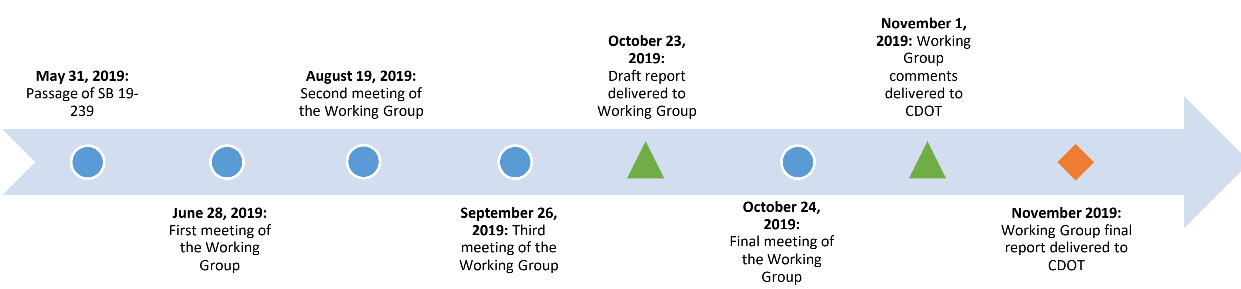
Table 1-2. Working Group Member Organizations per SB 19-239

SB 19-239 Guidance	Organization
Business representative—*A representative of businesses that provide package delivery services to end users of the goods in the packages for other businesses*	Amazon
Business representative—*A representative of businesses that hire drivers using personal vehicles for delivery*	CDOT invited Grubhub and DoorDash to participate in the Working Group and did not get a response
Business representative—*A representative of businesses that hire drivers to use their personal motor vehicles to deliver their own goods to end users of the goods*	Auto Alliance
Business representative—*A representative of towing and recovery professionals of Colorado*	Denver West Towing
Business representative—*A representative of autonomous vehicle manufacturers*	EasyMile
A labor representative	Teamsters Local 445
A labor representative—*A representative of persons with disabilities*	Denver Regional Mobility & Access Council
A labor representative—*A representative of persons who advocate for the protection of the environment*	Southwest Energy Efficiency Project (SWEEP)
A labor representative—*A transportation network company driver*	Lyft
A labor representative—*Any other individuals who the department deems necessary or appropriate to include in the stakeholder group*	High Performance Transportation Enterprise

1.3 Summary of Study Tasks

The Working Group, with technical support from CDOT, Colorado State University, and a consultant team, conducted the study and produced this report from June 2019 to November 2019. Several key milestones are identified in Figure 1-1. A summary of the specific technical activities and tasks follows.

Figure 1-1: Milestone Schedule



Literature Review: Literature review with assessment of 1) the state of the regulatory environment and 2) the state of adoption for emerging mobility technologies on a national level and exploration of over 250 publications.

Working Group: Establishment of a Working Group and associated subcommittees to assess issues, study alternatives, and make policy recommendations.

Analysis and Modeling: Technical analysis of alternatives and recommendations conducted by assigned project staff. Tools employed include travel demand modeling, economic forecasting, and geo-spatial visualization.

Agency Coordination: Coordination with CDOT, High Performance Transportation Enterprise, the Colorado Energy Office, Colorado State Patrol, Colorado Department of Revenue, and the Colorado Public Utilities Commission with regard to the findings in the report, the impacts of the recommendations by the Working Group, and with regard to development of methods and procedures to implement the recommendations. This effort also included articulation of suggested roles and responsibilities for the digital infrastructure required to implement the recommendations.

Legislative Coordination: SB 19-239 requires CDOT to present the recommendations in the form of a report and any accompanying legislation to the General Assembly at its 2019 State Measurement for Accountable, Responsive, and Transparent Government Act hearing in mid-January 2020. CDOT must also provide a final written report to the Transportation Legislation Review Committee during the 2020 legislative interim.

Working Group meeting minutes with presentations are included in Appendix B. Subcommittee memos are included in Appendix I.

CHAPTER 2. EMERGING BUSINESS MODELS & PROVIDERS

2.1 Commercial Transportation Providers

SB 19-239 directs CDOT to consult with a stakeholder group to examine “the impacts of technological and business model changes related to **commercial vehicles**,” Further,

> *(3) (a) As used in this Section, unless the context otherwise requires, “Motor vehicle used for commercial purposes" means a motor vehicle that is used to provide passenger transportation services purchased through a transportation network company, as defined in section 40-10.1-602 (3), a peer-to-peer car sharing company, a car sharing company that does not use a peer-to-peer business model, or a company that provides taxicab service, as defined in section 40-10.1-101 (19), a motor vehicle that is rented out by a rental car company, and a motor vehicle that is used for residential delivery of goods.*
>
> *(3)(b) "Motor vehicle used for commercial purposes” does not include:*
>
> > *(i) A motor vehicle used to deliver goods that is used only to deliver goods:*
> >
> > > *(a) to addresses other than residences; or*
> > >
> > > *(b) that are delivered as freight;*
> >
> > *(ii) a motor vehicle that has a gross vehicle weight rating of more than fourteen thousand pounds; or*
> >
> > *(iii) a motor vehicle that is operated for the purpose of transporting passengers:*
> >
> > > *(a) under a contract with the Regional Transportation District created in Section 32-9-105, a regional transportation authority created pursuant to Part 6 of Article 4 of this Title 43, or any other governmental or public entity; or*
> > >
> > > *(b) by a common carrier, as defined in Section 40-1-102 (3), except as otherwise provided in Subsection (3)(a) of this Section.*

SB 19-239 covers the emerging commercial transportation providers defined in Table 2-1 that are operating Class 1, 2, or 3 motor vehicles (under 14,000 lbs. gross vehicle rate) for commercial purposes. SB 19-239 does not apply to motor vehicles used for commercial purposes that are used solely to transport goods to commercial businesses as freight, that are over 14,000 lbs. gross vehicle rate, or that are passenger buses operated by a governmental transportation agency or a common carrier. Based on the definitions set forth in SB 19-239, this report focuses specifically on the types of providers described in Table 2-1.

Table 2-1. Emerging Commercial Transportation Providers (Operating Class 1, 2, Or 3 Motor Vehicles)

Provider	Definition	Examples
Transportation Network Company	A company that relies upon a mobile application to pair drivers with riders, as defined in Section 40-10.1-602 (3)	Uber, Lyft, Hop Skip Drive
Peer-to-Peer Car Share	A car-sharing company that enables individuals to rent personal vehicles to others	Turo, Drift, Getaround
Non-Peer Car Share	A car-sharing company that operates a fleet of vehicles for use by individuals	Streetcar, ZipCar, SHARE NOW (formerly car2go), eGo, UHaul Car Share, Enterprise CarShare, Connect by Hertz
Taxi	A company that provides taxicab service, as defined in Section 40-10.1-101 (19)	Freedom Cabs, Curb, Metro Taxi, I am Yellow Cab, Green Taxi Cooperative
Car Rental	A company that rents vehicles to individuals	Enterprise, Avis, Hertz, Budget
Residential Delivery	A company that relies on a mobile application to pair commercial vendors/stores/restaurants to private drivers to deliver goods to residential addresses in personally owned or fleet-owned vehicles having a gross vehicle weight rating under 14,000 lbs.	Uber Eats, Door Dash, King Soopers residential, United Parcel Service (UPS), Fed Ex, Amazon Delivery Service Partner, AmazonFlex

2.2 Current Regulatory Environment

Car rental and taxi companies are long-established mobility providers, with regulations and fees that vary by jurisdiction (state and local) throughout the United States. Several states, airports, and local jurisdictions already have legislation and regulation in place for TNCs. Jurisdictions are also challenged about how to accommodate increasing numbers of peer-to-peer car-sharing and non-peer car-sharing companies and residential delivery services, especially related to e-commerce. For example, on December 1, 2018, the Colorado Department of Revenue started requiring state sales tax to be collected for internet (online) sales to be delivered to Colorado locations.

Colorado is not alone in trying to integrate these emerging providers into existing transportation systems so that they are accessible and safe. Thoughtful legislation, rulemaking, and policy changes are tools that can bring order and fairness to managing the impacts, while maintaining flexibility and autonomy of the business models that are quickly evolving.

2.2.1. Commercial Motor Vehicles

Federal and state regulations govern commercial motor vehicles. Commercial motor vehicles and operators are generally subject to federal and state safety regulations, such as driver qualifications, vehicle inspection and maintenance, equipment, United States Department of Transportation (USDOT) numbers/markings, insurance, hours of service, etc.

Federal

Vehicle weight classes are defined by the Federal Highway Administration (FHWA) and are used by the agency, in addition to the U.S. Census Bureau and the U.S. Environmental Protection Agency. These classes, 1-8, are based on gross vehicle weight rating (GVWR), the maximum weight of the vehicle, as specified by the manufacturer. GVWR includes total vehicle weight plus fluids, passengers, and cargo.

FHWA categorizes vehicles as Light Duty (Class 1-2: up to 10,000 lbs.), Medium Duty (Class 3-6: 10,001 – 26,000 lbs.), and Heavy Duty (Class 7-8: 26,001 – 33,001 lbs.).[21] Classes 1, 2, and 3 can be characterized as cars, vans, and mini buses, primarily used to transport passengers. The higher classes and weights are larger vans and trucks that are equipped to transport cargo.

Title 49 Subtitle B Chapter III Subchapter B PART 390—Federal Motor Carrier Safety Regulations paragraph 390.5 defines a commercial motor vehicle as a vehicle over 10,000 lbs. that is used on a highway in interstate commerce to transportation passengers or property.[22]

Each state has an option of adopting its own definitions for its versions of the safety regulations. For purposes of examining the issues set forth in Colorado's SB 19-239, the bill defines a vehicle used for commercial purposes as vehicles having a gross vehicle weight rating (GVWR) of under 14,000 lbs. Within FHWA's vehicle weight classification, SB 19-239 applies to Class 1, 2, and 3 vehicles, which include light-duty and the lowest category of medium-duty vehicles.

The Colorado Department of Revenue tracks the number of registered vehicles in Colorado by vehicle class (Table 2-2). Based on these numbers, approximately 98% of registered vehicles in Colorado fall into the vehicle classes covered by SB 19-239.

Table 2-2. Registered Vehicles In Colorado By Vehicle Class

Class	Weight	Count of Class
Class 1	0 to 6,000 lbs.	5,787,678
Class 2	6,001 to 8,500 lbs.	308,807
Class 2b	8,501 to 10,000 lbs.	31,955
Class 3	10,001 to 14,000 lbs.	47,112
Class 4	14,001 to 16,000 lbs.	22,213
Class 5	16,001 to 19,500 lbs.	28,472
Class 6	19,501 to 26,000 lbs.	21,126
Class 7	26,001 to 33,000 lbs.	9,946
Class 8	33,001 + lbs.	10,885
	TOTAL VEHICLES	6,268,194

Source: Colorado Department of Revenue

Colorado

In Colorado, PUC Rule 4 CCR 723-6, Rules Regulating Transportation by Motor Vehicle, regulates commercial vehicle usage for TNCs and taxis. Commercial delivery providers are regulated by the U.S. Department of Transportation.

TNCs are covered under SB 14-125[23], which gives regulatory authority to the PUC, similar to that of taxis and other services that transport passengers. The PUC does permit each of the three TNC companies operating in Colorado. The PUC does not track nor have a record of the TNC drivers and vehicles currently operating in Colorado. The PUC does not collect data on the number of TNC trips operating on Colorado roadways each year.

The PUC's Transportation Rules do not currently regulate car share, rental car, or residential delivery providers.[24]

Table 2-3 summarizes the details of the rules, regulations, and requirements related to commercial motor vehicle companies, drivers, vehicles, and fares/fees in Colorado. A more detailed version of this table is included in Appendix C (Regulations and Requirements for Emerging Transportation Providers in Colorado).

Table 2-3. Regulations and Requirements for Emerging Transportation Providers in Colorado

Type	Regulating Agency	Company Requirements	Driver Requirements	Vehicle Requirements
Transportation Network Company Uber, Lyft, Hop Skip Drive	PUC Senate Bill 2014-125 TNC Rules 6700-6799	TNC Insurance Alcohol Policy Review Driver History annually, Criminal History Check and National Sex Offender Database of Driver Trip logs	Primary Driver Liability Insurance of $1M Health Certificate-driver is medically fit to drive 12 hours of consecutive driving, must be 21 years old Cannot log in after 16 cumulative hours; Cannot log in more than 70 hours in 7 day period	Automobile Insurance Proof of Colorado Vehicle Registration Vehicle Safety inspection annually Referral ADA rider to another service with appropriate equipment
Taxi Freedom Cabs, Curb, Metro Taxi, I am Yellow Cab, Green Taxi Cooperative	PUC US Department of Transportation 4 CCR 723-6 Part 6: Rules Regulating Transportation by Motor Vehicle	Trip logs 24 hours a day service in certain densities. Certificate of Public Convenience and Necessity Contract Carrier Permit Exempt Passenger Carrier Registration	Background check Health certificate	Taxi license plate Cab number inside vehicle Not allowed to multi-load without permission; minimum number of operating vehicles in several counties
Commercial Parcel and Package Delivery UPS, FedEx, DHL	U.S. Dept. of Transportation	Background check	Class C Commercial Driver's License (CDL) (FedEx cargo van driver) or no CDL (UPS parcel driver) Safe driving record	No commonly established vehicle requirements
Independent Contractor Package and On-Demand Delivery Amazon Flex, Grubhub, Postmates, GoShare	None	Background check and other employer requirements	Commercial vehicle insurance may be provided (Amazon Flex) 19 – 21 + or over with valid driver's license	Mid-sized 4-door sedan or larger vehicle (Amazon Flex) Vehicle no older than 15 years (GoShare) No commonly established vehicle requirements for other independent food and good deliveries.
Commercial On-Demand Delivery King Soopers residential, Walmart	State and federal commercial motor vehicle regulation	Employer requirements vary	18 years of age and safe driving record	No commonly established vehicle requirements food and good deliveries.

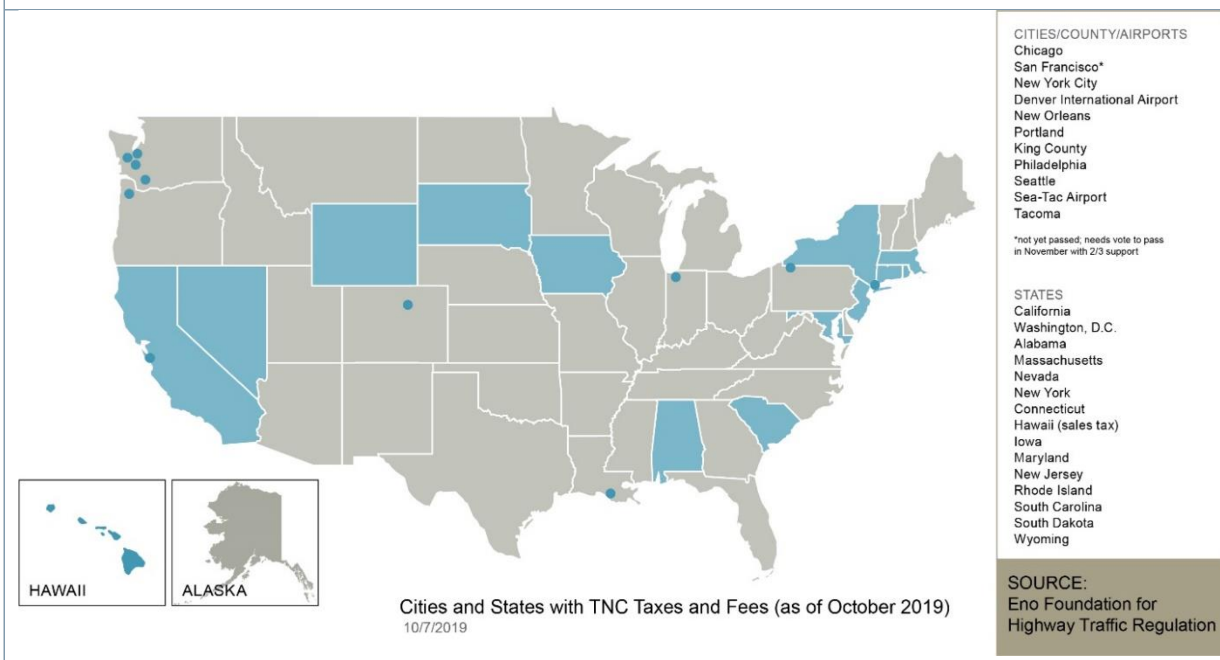
Other Regulatory Agency Examples

Across the U.S., emerging mobility providers are regulated by a variety of agencies, including state utility commissions, departments of revenue, local agencies, state departments of transportation, and/or the USDOT. Regulations are accomplished through legislation, rule-making, ordinances, etc. In addition, many airports are charging TNCs a fee to pick up passengers. Some also charge for drop-offs, an annual permit fee or a one-time operating fee, and trip fees.

The methods of regulation include taxing, per stop charges, permitting fees, etc. Often, incentives are built into the regulations for car shares or ZEVs. For example, Portland, Oregon, and the State of New Jersey have a $0.50 fee per trip for TNCs. In New Jersey, the fee is halved to $0.25 per trip, if the ride is shared. In another example, the State of Colorado imposes a Roadway Safety Charge on car rentals in the amount of $2 per day, but this is not imposed upon non-peer car-sharing companies. The City and County of Denver requires an annual parking fee for non-peer car-sharing companies to operate. The Colorado Public Utilities Commission requires an annual $50 fee on taxis to operate in Colorado.

The detailed information that was collected regarding taxes and fees for TNCs for the jurisdictions shown in Figure 2-1 and for ZEV regulations is included in Appendix C (Peer Research on TNCs).

Figure 2-1 Jurisdictions with TNC Taxes or Fees



2.2.2. Health Certificate for Drivers

To obtain a Colorado driver license, an applicant must complete a "vision screening" at the Department of Motor Vehicles to determine if the applicant sees well enough to drive a vehicle safely. In some cases, an applicant may be asked to also complete a self-reported "physical aptitude analysis."[25]

Section 5(a)(IV) of SB 19-239 requests the Working Group to conduct an "Examination of repealing the requirement of Section 40-10.1-605 (1)(d)(IV) that a transportation network company, as defined in

Section 40.10.1-602 (3), possess proof that a transportation network company driver, as defined in section 40-10.1-602 (4) is medically fit to drive." This section of the report provides background on the specific regulatory requirements for a health certificate in Colorado and in two other jurisdictions. Chapter 7 of this report provides a summary of the recommendations from the Working Group concerning this issue.

In Colorado, the Department of Regulatory Agencies PUC Transportation Section is responsible for:

- The safety and insurance oversight of passenger carriers, household goods movers, and towing carriers that operate on a for-hire basis in Colorado,
- Permitting hazardous and nuclear materials carriers, and
- Rate regulation and market entry for common carriers and contract carriers.

SB 14-125 related to TNCs made the distinction between TNCs and motor carriers and required that a TNC, before permitting a person to act as a driver on its digital network, shall confirm, "40-10.1-605 (1)(d)(IV) within ninety days of the effective date of this part 6 and pursuant to commission rules, proof that the person is medically fit to drive."[23]

The PUC adopted separate, but similar, rules for motor carriers and TNCs that are similar to the Federal Motor Carrier Safety Administration's regulations (49 CFR 300-399). 49 CFR part 391.41 (a)(1)(i) states that,

> "A person subject to this part must not operate a commercial motor vehicle unless he or she is medically certified as physically qualified to do so, and, except as provided in paragraph (a)(2) of this section, when on-duty has on his or her person the original, or a copy, of a current medical examiner's certificate that he or she is physically qualified to drive a commercial motor vehicle."

Motor Vehicle Regulations and Rules

The PUC has established rules under 4 CCR 723-6 (Rules Regulating Transportation by Motor Vehicle[24]) that cover commercial motor carriers, including taxis, shuttles, and luxury limousines. Rule 6107 states that a motor carrier driver must be medically qualified to drive as demonstrated by a current medical certification card or waiver. Rule 6109 (Proof of Medical Fitness) states that the medical certification must be issued by a licensed medical practitioner after a physical examination and completion of the PUC's medical examination report and package. Rule 6107(b) stipulates that the driver must have in his/her possession, when on duty, a medical examiner's certificate that he or she is physically qualified to drive a commercial motor vehicle, or must have in his or her possession a medical waiver or variance per Rule 6003(b) and 6107(b). Similarly, the certification is valid for no more than a period of two years.

TNC Regulations and Rules

TNC drivers must be medically certified and examined pursuant to PUC Rule 6713 or the Federal Motor Carrier Safety Administration regulations (49 CFR part 391.41). The PUC rules stipulate that TNCs must maintain copies of medical certificates for all drivers authorized to operate on their platform. TNCs must also require drivers to maintain a copy of their current medical certificate and any waivers or variances issued on their person or in their vehicle in physical or electronic form (State of Colorado, PUC Rules 6710[c] and 6713[d]). The TNC medical certificate is valid for no more than a period of 2 years. The PUC does not review each driver's medical certificate. However, the PUC has the authority to inspect medical certificates and other required documents for compliance upon request.

Drivers can file for petition of a waiver of the PUC rules. In July 2014, the PUC received approximately 155 petitions for waivers, but these included waivers related to topics other than medical certification. In addition to a valid driver license, vehicle inspection, criminal record check, driving history check, and other required documents, a driver's application to the TNC must include a valid medical certificate.

Once drivers have met these minimum requirements (as established by the PUC Rules and Section 40-10.1-605 of the Colorado Revised Statutes), TNCs may allow them to operate on their platforms. Drivers can obtain, at their own cost, a medical certificate from a qualified health provider. TNCs have indicated that it is sometimes expensive for drivers. Some TNCs may choose to bear this cost for their drivers in the Denver metro area. Potential drivers in rural areas of the state need to find their own medical provider to obtain the medical certificate. Obtaining the medical certificate can delay the onboarding process or, due to cost and/or lack of access to a medical provider, act as a barrier for a driver to onboard as a driver entirely, especially for those who are looking to drive part time for short periods (i.e., students working over a summer break).

To enhance the understanding of TNC regulations regarding health qualifications for drivers, data requests were made to the TNCs regarding the following:

- Number of drivers who fail the medical examination.
- Cost of health certificate for drivers during onboarding.
- Crash rates of drivers in Colorado compared to crash rates of TNC drivers in states that do not have a health certificate requirement.

Based on feedback from the TNCs, some of this data may not be available, and many providers requested a non-disclosure agreement before sending the data that is available. CDOT is currently developing a non-disclosure agreement for emerging mobility providers.

The PUC conducts random checks to verify that the TNC driver and driver are in possession of the medical certificate, as well as other required documentation, such as a driver's license and vehicle inspection form. If found in noncompliance, the PUC notifies the relevant TNC, which then may deactivate the relevant driver. The PUC may also fine TNCs. Fines may range from $275 to $2,500 per violation.

Other Jurisdictions

Current requirements for medical certification for TNC drivers in other jurisdictions were researched to investigate options for Colorado. The other jurisdictions have requirements under different regulatory structures. Some examples include:

- **Honolulu.** Sec. 12-6.5(c) "In order to determine if a driver is qualified for certification, the private transportation company shall, at a minimum, obtain records to establish that the driver: ....Has certified that the driver is physically and mentally fit to be a private transportation driver and is free of any known medical condition that would put a passenger at risk;". The applicant clicks

"Acknowledge" on a Medical Fitness prompt in onboarding flow.[26] Note that the drivers self-report their medical health status.

- **Kentucky**. Section 6 (4) “A TNC shall also require that each TNC driver...(g) Provides a written or electronic affirmation that he or she is fit and able to operate a motor vehicle to provide TNC services.” The applicant acknowledges Terms of Service.[27] Note that the drivers self-report their medical health status.

In New York City, companies like Uber and Lyft, instead of operating as TNCs, operate under the New York City Taxi and Limousine Commission’s “for-hire vehicle” regulations. This category of “High Volume for Hire Services” is different than and requires higher fees than operating as a TNC/rideshare provider in other parts of the United States. New York City drivers must get a special driver license from the Commission; and the vehicles are separately licensed by the Commission. For the application, drivers must submit a Medical Certification form completed by a licensed physician.

2.3 Current Fee Structures in Place

The regulating agencies described in Section 2.2.1 assess fees on emerging mobility provider companies, as shown in Table 2-4. Additional details supplementing Table 2-4 with TNC and EV fees for other jurisdictions can be found in Appendix C (Peer Research on TNCs and Peer Research on EVs). A detailed table of information researched regarding the fees and taxes paid by emerging mobility providers in Colorado is also included in Appendix C (Summary of Fees and Taxes on Emerging Mobility Providers in Colorado).

Table 2-4. Representative Fee Structures Assessed on Companies

Type	Colorado	Other Jurisdictions
TNC*	$110,250 per TNC annually to the PUC Denver International Airport charges $2.60 per trip for both pick-up and delivery	Percent of Fare: Cities/States: 1.0% to 7.0% Flat Fee per Ride: Cities/States: $0.10 to $0.72 Airports: $2.60 to $5.72 Surcharges applied to certain destinations, primarily airports; also congestion surcharges
Taxi	Annual vehicle identification fee for stamp ($50) Denver International Airport charges a $5.03/trip for pick-up	Many taxis pay “medallion,” stamp, or “hack licenses” fees. In most states, sales taxes do not apply because they’re considered services like lawn care and pool cleaning.
Car Rental**	$2.00 per day daily road safety program fee According to the annual budget of Colorado Department of Revenue, these fees generated $ 34 million in 2018. These funds go into the general budget for CDOT.	On a national basis, car rental fees vary state by state. According to the National Conference on State Legislatures approximately 40 states leverage a charge on rental cars. This may be in the form of an excise tax, daily fee or both. Fifteen states also authorize local governments to impose their own fees. States with the highest fees include: Minnesota, Maryland, Maine, Alaska, Arkansas, Texas, Virginia, and Washington D.C. with fees at 10% or more.[28] A complete listing of rental car fees by state is included in Appendix C (Car Rental Fees by State).

Table 2-4. Representative Fee Structures Assessed on Companies

Type	Colorado	Other Jurisdictions
Peer-to-Peer Car Share*	Currently none.	States have separate car-sharing taxes or do not specifically impose taxes. For example, Maryland and Indiana have lower tax structures for car sharing than for car rentals. The reasoning is that rental vehicle companies don't pay sales tax on their fleets and charge their customers for the registration costs. These registration costs are often passed on as a "vehicle licensing cost recovery" fee.
Non-Peer Car Share	Colorado exempts car sharing from the daily car rental fee (Colorado Revised Statutes § 43-4-804) Denver International Airport extends airport concession fees to car-sharing firms; bill pending (SB 19-090) City & County of Denver car share program: Citywide permit - $850/vehicle/year; Dedicated space - $250-$750/year	States have separate car-sharing taxes or do not specifically impose taxes. Some states (Florida, Pennsylvania, and Massachusetts) have imposed car sharing-specific taxes and fees that are distinct from and less than analogous car rental taxes and fees.
Residential Delivery/ E-Commerce*	Currently none.	Information not readily available.

*Car owners in peer-to-peer car share programs, TNC drivers, and residential delivery/e-commerce drivers using personal cars are subject to road safety program fees and annual vehicle registration fees, as are imposed on every personal car owner.
**Rental car companies do not pay sales tax for their vehicles; registration and ownership costs are recovered from the renters via a "VLF REC" fee, also known as the "vehicle licensing fee recovery."

2.4 Impact of Emerging Providers on the Way Coloradoans Travel

There are many challenges and opportunities to mitigate the economic, environmental, and transportation infrastructure impacts of commercial transportation providers operating both traditional ICE vehicles and electric vehicles used for commercial purposes. Chapter 4 presents the impacts of mobility providers in terms of VMT and emissions.

2.4.1. Economic Impacts

The economic impacts of emerging mobility technologies are still uncertain. The relative immaturity of these technologies means that economic impacts are just now starting to be seen. Congestion, safety, job gain or loss, transit usage, and effects on other industries are all part of the economic impact equation.

While some studies have been conducted that begin to analyze and attempt to project economic impacts, a clear picture has not yet emerged. One complicating factor is the fact that many of these emerging companies have yet to make a profit, so forecasting their ability to continue to be a disruptive force in these industries is risky. Another complicating factor is that the total numbers of TNC drivers, TNC trips per day, or distances of TNC trips are unknown, because those using the app are not required to disclose their operation to the State of Colorado. Similarly, the total number of peer-to-peer car share, non-peer car share, and car rentals that occur each day in Colorado is unknown.

In spite of these uncertainties, some trends are compelling. During the same time period that TNC ridership and earning opportunities for new drivers in many areas of the country have increased, there has been a decline in taxi ridership and taxi jobs.[29] Some studies have shown that the rise of TNC usage and car-sharing usage (peer or non-peer) correspond to a decline in transit ridership and traditional rental car usage,[30] while other studies have shown increases in ridership with TNC availability. For example the American Public Transit Association study by Darnell Grisby noted that shared rides complement public transit.[31]

The effects on congestion, and its economic impact, are mixed. While some emerging mobility technologies likely increase congestion, others may reduce it. Car sharing can reduce overall car ownership since occasional drivers may no longer need a personal vehicle. TNCs have been cited as increasing congestion due to “deadheading,” but may reduce localized congestion because they eliminate the need to circle for parking.[10] Residential delivery services due to a rise in e-commerce and online shopping are a boon for consumers, who gain time and convenience. These services could mean more delivery vehicles on the road but less customers driving to brick and mortar stores; the overall impact on congestion is uncertain.

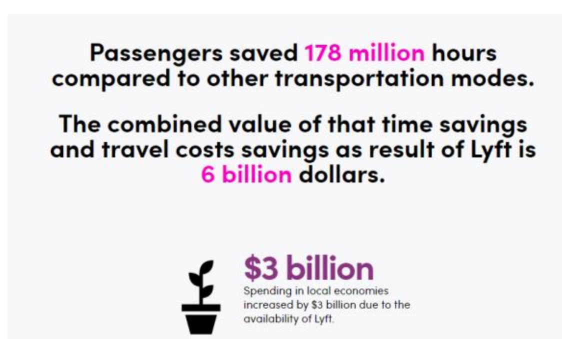
Positive impacts may include a reduction in the overall number of severe crashes that result from drunk driving. Although the research on the subject is not yet conclusive, according to the Highway Safety Manual, crash costs in 2016 dollars are $1,688,400 per fatality and $96,100 per injury.

Disadvantaged communities and rural communities currently have less access to the emerging transportation providers.[32] This equates to a lack of opportunity for these communities, but it also presents an opportunity to expand access to emerging mobility providers that can improve the lives of people in these areas of the state. Car sharing allows some people to avoid the cost of car ownership, a significant benefit to those who live in areas where this choice is feasible. TNCs and taxis reduce the need for parking, particularly in high-land-value areas, which allows for a higher and better use of that land. People with mobility limitations may not be able to walk to a transit stop, drive at night, or drive during adverse weather conditions. They, as well as those who cannot afford to own vehicle, may benefit from on-demand residential delivery available from emerging mobility providers to access goods and services.

One thing is certain, the emerging technologies will impact the economy, and a plan to ensure that the emerging technologies contribute to statewide economic growth will be important to allow for a thoughtful transition as these technologies mature.

2.4.2. Environmental Impacts

The emerging mobility technologies in question generally result in greater numbers of vehicles and greater VMT than what is on the transportation network today, which results in environmental impacts, especially in dense urban environments. These impacts include air quality, water quality, and environmental health.



Source: Lyft 2019 Economic Impact Report

Air quality concerns from vehicle emissions arise as a result of idling or increases in VMT caused by emerging mobility providers. TNCs have been shown to result in an increase in VMT from operators circling or traveling significant distances without passengers (deadheading). Residential delivery providers sometimes make inefficient trips, such as delivering items from one e-commerce order in separate trips. In some cases, the rise in emerging mobility options has resulted in a shift of some passenger trips away from more sustainable transportation modes, like transit. On the other hand, some studies have indicated that emerging mobility options like pedal assist bikes and scooters, along with transit integration, have helped better connect people with sustainable transportation modes and public transit[33].

Stormwater runoff can occur as a result of rain or snowmelt flowing over paved streets into creeks and rivers without treatment by a water reclamation facility. Increased VMT and more emerging mobility providers on the road add to the need to construct more roadway and highway capacity. Additional lane-miles add more impervious surface area, which increases stormwater runoff into adjacent waterways.

Some environmental health and social equity concerns are arising with the advent of these technologies because they sometimes do not provide services in rural areas and areas with social equity concerns. Increased VMT can increase exposure to noise, or unwanted sound. Noise is one of the most common environmental exposures in the United States, causing a wide variety of adverse health effects, from sleep disturbance to cardiovascular disease and increased incidence of diabetes.[34] Long driving commutes as a result of congestion are linked to stress and other mental health impacts.[35] Furthermore, studies show that people living in areas with high VMT per capita have poorer health outcomes due to reduced physical activity.[36]

There are opportunities to reduce these impacts, however, with technology improvements, regulation, and/or fees. Through these means, TNC and taxi deadheading can be reduced, saving emissions and resources. Similarly, differences in the impacts of regulations on taxis and TNCs will need to be examined in more detail. Increased numbers of households participating in car sharing programs result in fewer vehicles on the road overall.[37] The emerging mobility providers offer an opportunity to reduce the land needed for parking lots in urban areas; impervious surfaces could be reallocated to greener uses, like green infrastructure.

2.4.3. Transportation Systems

Impacts to transportation systems from these emerging mobility technologies are considerable. From additional congestion, to safety concerns, to reduced transit ridership, to increased medium-duty VMT and many other impacts, the way our transportation system is used will be altered by the transition to these technologies.

TNCs and residential delivery services may result in greater wear and tear on streets and highways through increased VMT. Travel mode shifts from transit to other providers could reduce the efficiency of the transit networks and may result in cuts to service for those using transit.

On the other hand, many of these technologies represent an opportunity to reimagine inefficient parts of the transportation system. Properly aligned, TNCs, car shares, and taxis could in fact increase transit utility by providing valuable first-and-last-mile connections. Similarly, reimagining the way curb space is used can result in greater efficiencies for many different types of travelers beyond personal auto users. Residential delivery could result in VMT reductions if efficient package bundling and trip routing are implemented. Similar to electric vehicle adoption, the adoption of automated vehicle technology can be accomplished faster at the fleet level, which could have operational benefits if properly implemented (though this is not certain). For these reasons and more, embracing these technologies can lead to enhanced operations and safety on our existing system.

The Working Group explored these challenges and opportunities in more detail. The results of the study are detailed in the remaining chapters.

CHAPTER 3. DATA COLLECTION AND RESEARCH

3.1 Literature Review

The Systems Engineering and Mechanical Engineering Department at Colorado State University conducted a literature review for as a component of this study. Dr. Erika Miller led the effort to provide a broad overview of how other states, transportation agencies, and other entities have examined the transportation system impacts of the adoption of new and emerging technologies and business models. Detailed information on the topics covered and the results of this literature review were provided to the Working Group. These documents are contained in Appendix D. Dr. Miller highlighted potential impacts of new and emerging technologies and business models on transportation system, focusing on the transportation providers covered under SB 19-239. Dr. Miller illustrated the state of the industry of the emerging technologies types as well as peer city and international practices in response to the changing transportation landscape.

3.2 Additional Data Collection

The subcommittees made several requests for research into specific topic areas to inform and guide their process. Three research papers explore topics that were intended to inform the recommendations. The papers summarize the research and analysis requested by the subcommittees. These research papers, titled "Transportation Provider Service Coverage in Disadvantaged Areas in Colorado," "Barriers to Trip Sharing in Emerging Mobility Technologies," and "Barriers to ZEV Adoption" can be found, respectively, in Appendix E and Appendix F.

3.3 Transportation Provider Travel Activity

Research and data requests to the transportation providers were completed with the intent of understanding the travel patterns and approximate VMT for the six emerging transportation provider types covered under SB 19-239. The research was also intended to reveal if there was consensus on 2030 growth projections in each of the transportation provider industries. This effort included an additional literature review, supported by information, such as articles, reports, and letters. Data requests were sent to approximately 30 transportation providers. Several of these data requests were fruitful, while other providers were unresponsive or requested a non-disclosure agreement (currently being developed). In addition, various types of data are not available due to the emerging TNC market, e-commerce, and on-demand residential delivery services. The preliminary study findings were presented to the Working Group members who provided insights on the accuracy of the VMT estimates and other study results. A complete overview of the data request process can be found in Appendix D. This research was shared with the Working Group, incorporated into this report, and used to develop estimates of travel activity and projections for industry growth.

For estimating elasticities regarding the impact of potential fee structures on the emerging mobility providers, a focused literature search was conducted, which is presented in Chapter 5.

In addition, a series of interviews were conducted with Working Group members. The goal of the interviews was to understand stakeholder perspectives on recommendations and to capture stakeholder opinions and ideas regarding the process and the final Working Group meeting.

CHAPTER 4. TRANSPORTATION IMPACT ANALYSIS

4.1 Overall Approach

4.1.1. Travel Demand Modeling and Forecasting

One of the objectives of the study was to estimate the travel impacts of six emerging and shared mobility modes in the Colorado. It should be noted that there is high uncertainty in the estimates because of a lack of data as some of these emerging mobility options are new and changing considerably over a relatively short period of time. Colorado does not have data on the number of vehicles, numbers of trips, or trip lengths that are completed by the majority of these modes. For example, data on residential delivery was extremely limited since the behaviors of firms and drivers are not as widely understood and/or available compared with information on consumers. The Working Group and subcommittees recognized the lack of complete and relevant data and compressed time frame of the study that didn't allow inclusion in the model of all of potential parameters to reflect the nuances of the emerging mobility modes and travel behavior. Suggestions for additional data analysis needs specific to modeling are listed in Section 7.1.3.

Because estimating travel for these emerging mobility providers has never been done before in Colorado, the first step involved a literature review and data gathering. Where local data was not available, data from other parts of the country were reviewed and translated or adjusted to account for Colorado characteristics like population and travel. The sources of the data and elasticity assumptions are well documented. If no data was available, such as data regarding e-commerce and residential delivery, the trip forecasts were extremely limited.

After a review of the data available, vehicle trips and VMT were estimated for the six modes. It should be noted that the VMT estimates are those vehicle miles on the road today; this study did not conduct an analysis of a number of other metrics, such as net increases or decreases because of the modes available or how much of the VMT is substituting for other modes of travel. This study focused on gathering any data available on number of person or vehicle trips, average trip length (with and without passengers, where relevant), and the resulting total VMT.

Travel in Colorado

The Colorado Statewide Travel Demand Model (StateFocus) forecasts all personal travel made by every Colorado resident, plus commercial truck travel and visitor travel to or from Denver International Airport. The model forecasts travel—trip origins and destinations by mode—for an average fall/spring weekday. The activity-based model's development and validation relied on the 2010 Front Range Travel Counts Survey for information on Colorado residents' travel behavior, as well as traffic counts and transit ridership. CDOT anticipates an updated survey to occur in 2020.

A wealth of data is used as input to the model in order to explain travel in the region. This includes information on people, households, schools, and employment (socioeconomic data); road, non-motorized, and transit networks (transportation supply); and other characteristics of the region. Outputs of the model include number of trips by mode and total VMT. Currently available forecast years include a base year (2015) and future years for 2030 and 2045. For this analysis, data from the 2015 and 2030 scenarios were utilized to understand socioeconomic characteristics of the population, travel behavior choices, and estimates of the total travel in Colorado. Table 4-1 provides some key metrics used in the analysis based on data input or output from the model.

Table 4-1. Key Metrics Used in the Analysis

Metropolitan Planning Organization	Population		Personal Daily VMT (1,000s)		Total Daily VMT (1,000s)	
	2018	2030	2018	2030	2018	2030
Denver Regional Council of Governments	3,326,689	4,058,025	71,103	86,013	81,908	99,165
North Front Range Metropolitan Planning Organization	580,625	766,748	11,720	16,505	13,145	18,437
Pikes Peak Area Council of Governments	732,811	892,270	13,242	17,205	14,942	19,395
Pueblo Area Council of Governments	166,198	200,731	3,052	4,094	3,400	4,528
Grand Valley Metropolitan Planning Organization	157,583	202,337	2,651	3,763	2,887	4,087
Non-MPO	731,659	854,354	22,432	30,687	24,696	33,549
Statewide	5,695,564	6,974,465	124,201	158,268	140,978	179,162

Notes:

A 2018 model scenario does not exist. Travel estimates were interpolated between 2015 and 2030 and adjusted to account for current 2018 population estimates from US Census.

Total Daily VMT includes personal travel and commercial truck travel.

A recent effort to enhance StateFocus included the addition of a TNC mode, which can be optionally included in model runs. Given insufficient data to re-estimate the model for TNCs, data collected prior to and during this study was used to reasonably calibrate the model based on borrowed sensitivities to various factors that influence the choice to use TNCs or other modes (such as time, cost, and auto availability in the household). However, a lack of observed data of TNCs in Colorado means that this model cannot be validated, but it can be used as a reference for analysis.

The Colorado Energy Office recently completed an Electric Vehicle Growth Analysis that examined different market and policy scenarios resulting in potential adoption rates of light-duty plug-in electric vehicles.[38] This analysis provided data on the number of trips of ICE vehicles compared to the number of ZEVs in the overall fleet in 2020 and 2030. The ZEV Plus policy scenario was assumed to account for ZEVs in the emissions analysis in this study.

Appendix G contains further information on sources and assumptions for all six emerging commercial transportation providers.

4.1.2. Emissions Modeling

Emissions modeling was completed using the current version of the U.S. Environmental Protection Agency's Motor Vehicle Emissions Simulator (MOVES) Version 2014b. MOVES estimates emissions for mobile sources for criteria air pollutants and greenhouse gases, measured as carbon dioxide equivalents (CO_2e). It is the primary tool used by MPOs to estimate emissions inventories for criteria pollutants identified by the National Ambient Air Quality Standards. The model can be run at a national, county, and project scale.

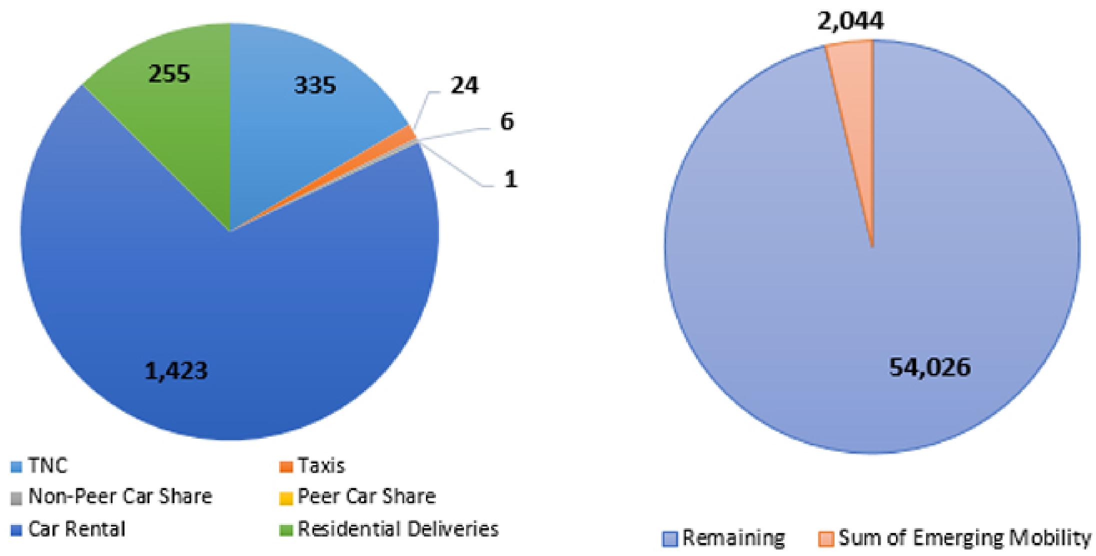
MOVES was run for the existing condition (2018) using the national level specific for Colorado for weekdays in January and July and averaging the two results (models are performed for weekdays because those are the primary days when commerce is conducted). This is important in Colorado since meteorology and travel demand are different between typical winter and summer conditions. Running MOVES at the national scale relies on the program's default settings/historical data for Colorado and is appropriate for planning applications like this study. Thus, data on fuel mix, vehicle type distribution, meteorology, and other inputs are based on historical information in the database.

For 2030, MOVES was run at the national scale for Colorado for weekdays in January and July, but with some changes. First, emissions factors were calculated by dividing emissions by activity level. Second, the percent of activity level assigned to each source type was calculated within the two CDOT categories: vehicles (including the ZEV adoption rate from the Colorado Energy Office study[38]) and heavy trucks. Third, the percent of each source type was multiplied by its corresponding CDOT VMT value to approximate VMT by source type in the StateFocus model. Finally, the adjusted VMT value was multiplied by the emission factors to produce emission per day. This change was performed to reconcile the VMT estimates indicated by the Statewide Focus Model with results from the 2030 MOVES model run. The 2030 MOVES forecasts resulted in statewide VMT for vehicles (less heavy trucks) of 139,800,000 (average of January and July), while the 2030 StateFocus model suggested statewide VMT at 158,270,000. This discrepancy is likely due to the growth rate assumptions embedded in MOVES. The most current version of MOVES was released in 2014, while StateFocus uses recent socio-demographic forecasts prepared by Colorado State Demographer. Therefore, the raw 2030 MOVES output of VMT were scaled to match VMT implied by the 2030 StateFocus model since it was important to be consistent with the VMT implied by the travel demand model and input socioeconomic data for 2030.

4.1.3. Statewide Baseline VMT and Emissions (all vehicles)

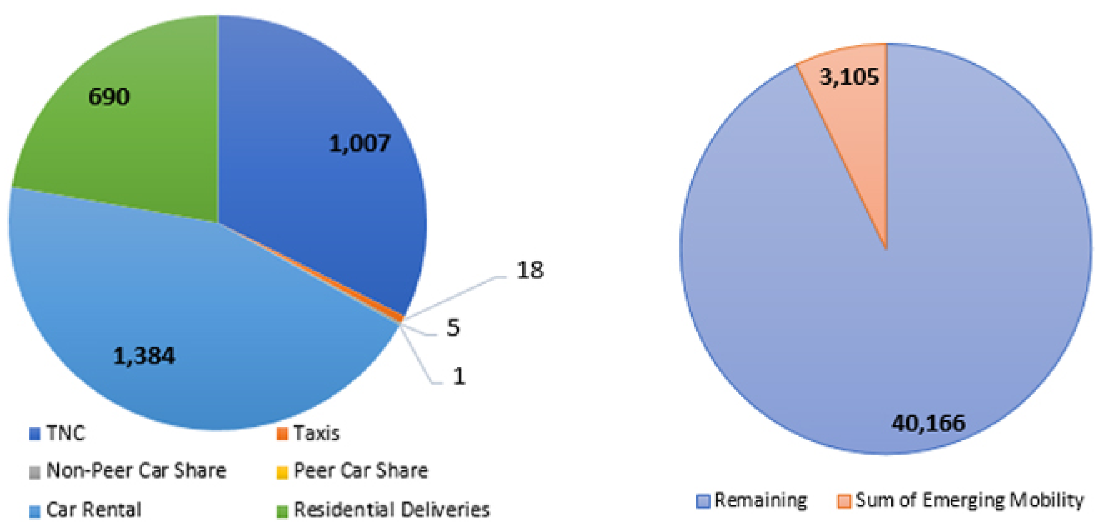
The statewide baseline VMT for 2018 is estimated at 124,200,900 for an average day (from the statewide model). This estimate includes all vehicles except heavy trucks. Intercity bus, transit bus, and school bus, which are included in the MOVES analysis, were removed from the emissions estimates (CO_2e) because the six sub-modes are unlikely to use these vehicles types and because they are not relevant to SB 19-239. The statewide baseline CO_2e estimate is 56,071 short tons per day (Figure 4-1).

Figure 4-1. 2018 Share of CO_2e Short Tons/Day



For 2030, statewide baseline VMT is estimated at 158,270,000 daily with the associated CO_2e estimate of 48,674 short tons per day (Figure 4-2). This decrease in emissions from 2018 reflects the higher Corporate Average Fuel Economy (CAFE) standards enacted in 2011 (reduced CAFE standards would increase the 2030 emissions estimates).This reduction in emissions also supports the Governor's objectives for emissions reduction included in HB 19-1261 (described in Section 1.1.2).

Figure 4-2. 2030 Share of CO_2e Short Tons/Day



4.2 Transportation Network Company Modeling

4.2.1. TNC Data Sources

In light of the growing popularity of TNCs in major metropolitan areas and that TNCs can no longer be considered a fringe mode of transportation, it is important to investigate how TNCs, such as Uber and Lyft, are affecting congestion—are they reducing congestion by complementing transit and reducing car ownership in major cities, or are there other effects? TNCs have been shown to be correlated to traffic congestion in cities like San Francisco[39] and Denver[10] in recent studies. TNCs represent a relatively new mode of transportation, but one that is demonstrably shaping and modifying extant transportation and mode choice trends.

It is very common to run into data availability issues with TNC research and application. Because of the proprietary nature of the data protected by these companies, it is not common for planners and demand modelers to have access to this data in as transparent a way as any other publicly or privately operated transportation mode. A few research studies have overcome this challenge by making use of different data collection methods. Additionally, household travel surveys and recently released publicly available TNC data at a disaggregate level provide another picture of TNCs in the United States. There was a limited amount of data on the number of single TNC trips compared to the number of pooled TNC trips. The primary sources of data used in this study to estimate TNC travel in Colorado include:

- 2015 Puget Sound Regional Council Household Travel Survey[40] and 2017 Puget Sound Regional Council Household Travel Survey.[41]
- 2017 National Household Travel Survey (NHTS).[42]
- 2018 publicly available TNC trip data from Chicago.[43]
- A 2016 study by Alejandro Henao in which the researcher became a TNC driver and collected both survey-based data, as well as TNC trip characteristics spread across various spatial geographies within Denver.[10]
- A 2018 study by Fehr & Peers that estimated TNC VMT for several large urban regions across the county, in comparison to the total VMT for those regions.[44]

It should be noted that the VMT estimates are those vehicle miles on the road today; this study did not conduct an analysis of a number of other metrics, such as net increases or decreases because of the modes available or how much of the VMT is substituting for other modes of travel.

4.2.2. TNC Baseline 2018 and 2030 Trips, VMT, and Emissions

After assessing the available data, this information was applied to Colorado, by a variety of different approaches, in order to approximate a reasonable range of estimated TNC travel. Those efforts resulted in the following estimates for TNCs in Colorado:

- 38,000 to 119,000 daily TNC vehicle trips, with a best estimate of 63,000.
- An average passenger trip length of 7 miles (observed values ranged from 3 to 8 miles).
- Deadheading travel (travel while waiting for TNC rider and travel to pick up a rider) of 40% (values ranged from 20%-50%) of the total TNC VMT per trip.

Assuming approximately 63,000 vehicle trips and 12 miles a trip (including deadheading) results in approximately 750,000 daily VMT, with a low estimate of 450,000 and a high estimate of 1,400,000 daily VMT per day in 2018. **Using the best VMT estimate, emissions associated with TNCs is estimated at 335 short tons per day of** CO_2e.

To forecast TNC travel in 2030, expected population and employment growth and the current trajectory of rapidly increasing TNC usage were two important considerations. Recent TNC data released for Seattle show a rapidly increasing number of TNC trips per day.[45] While it is expected that the use of TNCs will continue to increase, it is unclear where the level of saturation may occur. It should be noted that certain cities in Colorado have a higher density of TNC operators compared to others. Please see the Research Paper: Transportation Provider Service Coverage in Disadvantaged Areas in Colorado in Appendix E. A number of different approaches were used to estimate TNC travel in 2030. The primary estimates included:

- Application of StateFocus, which resulted in the same mode share (or propensities) estimated today in Colorado – an estimate of **81,000 vehicle trips.**
- Assuming an increase in TNC market will result in mode shares observed today in the Chicago region, where the density is similar to the forecasted density of Denver in 2030 – an estimate of **315,000 vehicle trips**.
- Assuming an increase in TNC market in Colorado will result in mode shares observed today in San Francisco, as an example of attainable TNC travel but much higher than experienced in Colorado or many other places in the country – an estimate of **850,000 vehicle trips**.

These analyses led to an estimated 81,000 to 850,000 TNC vehicle trips per day in Colorado in 2030, with a best estimate of 315,000 vehicle trips. Assuming the same average trip length and deadheading), estimates for 2030 TNC VMT range from 950,000 to 10 million. This translates to approximately 0.5% to 5% of forecasted 2030 total VMT. **Using the best VMT estimate for 2030 of 3,684,000, emissions associated with TNCs is estimated at 1,133 short tons per day of CO_2e**. This wide range of impacts underscores the need for better data (both number of daily trips and length of daily trips) and a better understanding of who, where, when, and why people use TNCs.

4.3 Car Share

4.3.1. Car Share Data Sources

Car share today is one of the popular emerging modes, newly accessible through apps in the shared economy. The main purpose of car sharing is to share a personally owned car or a fleet of cars with multiple users in an on-demand basis for a relatively shorter period of time. The renters, and owners of the cars are two end nodes of supply and demand of the network of car rental service, and car-sharing companies manage this demand and supply using an application-based network. For purposes of this analysis, two categories of car sharing were considered (based on the characteristics of the car owners): non-peer car-sharing service and peer or peer-to-peer car-sharing service.

Little to no data on car sharing in Colorado was available at the time of this study. Qualitative data has indicated that peer-to-peer car sharing may originate at airports and major mobility hubs and may be based in neighborhoods as well. Non-peer car sharing generally takes place in more urban areas of the state. Some studies of non-peer car sharing (particularly SHARE NOW [formerly car2go] and Zipcar services) were available for other locations. Limited studies of peer car sharing were available but were not locally specific or very current considering the rapidly evolving business models for the companies.

The primary sources of data used in this study to estimate car share travel in Colorado included:

- 2015 Puget Sound Regional Council Household Travel Survey[41] and 2017 NHTS.[42]
- Online news articles and reports about car sharing in Colorado.
- A 2016 study (Martin and Shaheen [2016]) assessment of the impacts of SHARE NOW (formerly car2go) on vehicle ownership, modal shift, VMT, and greenhouse emissions in five American cities.
- Studies from Portland State University (Dill, et al [2016]) based on surveyed vehicle owners and renters using the Getaround platform.
- A study by University of California, Berkeley (Shaheen et al. (2018)) surveyed users of multiple peer-to-peer car-sharing operators, collecting behavioral statistics, including monthly trip frequency and monthly spending on peer-to-peer car sharing.
- A University of California, Berkeley (Stocker et al. [2016]) study that conducted a survey to better understand the impact that car sharing has on travel behavior.
- Estimates of fleet size for car sharing apps in Colorado by manually counting the average number of vehicles available on an average weekday.

The Puget Sound Regional Council and NHTS surveys asked respondents how often they use car-sharing services. Analysis and application of that data to Colorado resulted an estimated range of 4,100 to 21,000 cars haring person trips per day, or 2,000 to 10,000 car-sharing vehicle trips today, assuming an average vehicle occupancy of 2.08 (as estimated from NHTS data). As described below, the lower end of this range is reasonable compared to estimates of non-peer plus peer car sharing. **The higher end of this range, 10,000 vehicle trips, with a high estimate of 50 miles per day, results in a high estimate of 500,0000 VMT for all car sharing today**.

Application of Puget Sound Regional Council survey data to 2030 population forecasts for Colorado results in a high estimate of approximately 55,000 vehicle car-sharing trips per day in 2030. Assuming the same high 50 miles per day estimate results in a high estimate of 2.8 million VMT for car sharing in 2030 in Colorado.

It should be noted that the estimates for non-peer car share were developed before SHARE NOW (formerly car2go) announced their departure from Denver.

4.3.2. Peer Car Share

Baseline 2018 and 2030 Trips, VMT, and Emissions

The primary operators for peer car sharing in Colorado include Getaround and Turo. The available data on the internet indicates their available fleet sizes were 100 and 200, respectively. Very little is known about how often these vehicles are rented or their durations or miles traveled. A Portland State University study estimated the number of trips on peer car-sharing vehicles to be 0.4 trips per day, on average. Some rentals can be short-term (an hour) or long-term (multiple days). Given the lack of data, the Zipcar trip length assumption noted above was used here—a 15-mile average trip length (per reservation per day). To check for reasonableness, an individual's vehicle rental history on a peer car-sharing platform was mined. It revealed an average of 0.5 reservations per day and an average rental duration of 19 hours, suggested that a longer average VMT estimate may not be unreasonable. This average duration of 19 hours is per reservation and includes multiday rentals.

Assuming 300 available vehicles on any given day and 0.4 trips per day results in a best estimate of **100 vehicle trips per day**. Due to the uncertainty of average trip length, a range of 15 to 50 miles per day was assumed, resulting in **1,800 to 2,700 VMT per day for peer car sharing in 2018**. In calculating emissions, a conservative estimate of 1,800 VMT per day for 2018 was used, which results in roughly one short ton per day of CO_2e. It should be noted that there is high uncertainty in these estimations due to lack of recent or local data.

Without historical trend data or better information about future use of peer car sharing, an assumed increase proportional to expected growth in travel in Colorado (25% between 2018 and 2030) results in a best estimate of **200 vehicles trips and 3,600 VMT for peer car sharing in 2030 in Colorado.** Emissions associated with peer-to-peer car share are approximately 1 short ton per day of CO_2e in 2030.

4.3.3. Non-Peer Car Share

Baseline 2018 and 2030 Trips, VMT, and Emissions

Non-peer car share operators in Colorado today include SHARE NOW (formerly car2go) and Zipcar (although SHARE NOW has indicated it will be canceling its services in Colorado on October 31, 2019). These two companies have very different business models:

- SHARE NOW includes a floating network of vehicles that can be dropped off anywhere within its service boundaries and lend themselves to shorter duration rentals.
- Zipcar includes a network of vehicles that are picked up and dropped off at specific location and are often used for longer duration rentals.

The SHARE NOW fleet was reported as 340 vehicles in Denver in 2017[46] with a customer base of 48,000 in 2018[47]. Martin and Shaheen (2016) estimated five customer trips per vehicle per day with average trip lengths ranging 3.4 to 4.1 miles and repositioning travel ranging from 3% to 17% of total fleet VMT, the higher end being for SmartCar fleets requiring electric charging. A local news article reported the average trip length of SHARE NOW trips in Colorado was 6.83 in 2018[48]. Assuming 340 vehicles with 5 trips each per day, an average trip length of 6.83 miles, and 3% of vehicle fleet VMT for repositioning, **1,700 vehicles trips and 12,000 VMT are estimated per day for** SHARE NOW.

The Zipcar fleet was estimated to be 55 vehicles across Colorado in 2019. Stocker et al. (2016) The estimated the average VMT per reservation was approximately 50 miles, but this included reservations for more than one day, so the average amount of travel in one day is unknown but likely to be lower. Considering that the Zipcar model is more similar to the peer-to-peer car share model (in terms of having to return the vehicle to a specific place and lends itself to longer rental durations), the same assumptions of average trip length were assumed for both. It is unclear how often vehicles are rented. Based on information provided by various peer car-sharing studies and professional judgment, a 15-mile per day trip length, which is about the same mileage an average person drives an average day, was assumed. Because vehicles are returned to specific space, and with no better information, no repositioning VMT was assuming. With these assumptions, **50 vehicle trips and 1,000 VMT are estimated per day for Zipcar**.

Based on above estimates for SHARE NOW and Zipcar, 1,800 vehicle trips and 12,800 VMT are estimated for 2018. Emissions associated with non-peer car share are six short tons per day of CO_2e.

Without historical trend data or better information about future use of non-peer car sharing, an assumed increase proportional to expected growth in travel in Colorado (25% between 2018 and 2030) results in an estimated **2,500 vehicles trips and 20,000 VMT for non-peer car sharing in Colorado in 2030.** Emissions associated with non-peer car share are six short tons per day of CO_2e in 2030.

4.4 Taxi

4.4.1. Taxi Data Sources

Taxis have been regulated in Colorado for a long time. Therefore, reliable data of taxi travel is available from the PUC and was provided for years 2013 to 2017.

4.4.2. Taxi Baseline 2018 and 2030 Trips, VMT, and Emissions

The data provided reveals an average of 5,500 vehicle trips per day in 2017 and an average passenger trip length of 4.8 miles. The PUC advised to assume the total taxi miles traveled are double the paid miles. This results in an estimate of 53,000 daily VMT by taxis today.

While researchers are confident that this is a reasonable estimate of taxis in Colorado, it should be noted all taxi providers who reported to the PUC were in the Denver metro region. Taxis in the Denver metro area are limited to pick up in 9 counties (Boulder, Broomfield, Adams, Denver, Arapahoe, Jefferson, Weld, Larimer, and El Paso), but may drop off a customer anywhere. Taxis do exist outside of the Denver metropolitan region but data was not readily available. Considering the population outside of the Denver region, taxi trips were increased by 28% to account for potential unreported taxi travel, a high estimate of taxi travel in Colorado. A 28% increase represents the population in 2018 that is outside the Denver Regional Council of Governments region but has taxi service (North Front Range Metropolitan Planning Organization and Pikes Peak Area Council of Government regions) divided by the total population in all regions with taxi service (Denver Regional Council of Governments, North Front Range Metropolitan Planning Organization, and Pikes Peak Area Council of Governments).

Assuming approximately 5,500 to 7,000 vehicle trips and 10 miles a trip (including deadheading) results in approximately 53,200 VMT, with a high estimate of 70,000 VMT per day in 2018. Using the lower estimate of 53,000 VMT today, emissions associated with taxis are 24 short tons per day of CO_2e.

To forecast taxi travel in 2030, a few approaches were utilized to estimate the range of future possibilities:

- Taxi trips will continue to decline at the currently observed rate, which would result in 0 taxi trips before 2030; and
- Taxi travel will increase proportionally with expected growth in travel in Colorado (25% between 2018 and 2030), applied to the best and high estimates of taxi travel today.

These assumptions lead to a range between 0 to 8,700 taxi trips per day in Colorado in 2030, with 6,900 vehicle trips as the best estimate. The VMT assuming the best estimate of taxi trips is 66,700. Emissions associated with taxis are 21 short tons per day of CO_2e in 2030.

4.5 Car Rental

4.5.1. Car Rental Data Sources

Car rental companies, like taxis, have existed in Colorado for a long time. Since 2010, every car rental is charged a $2 per day fee that is collected by the state and reported by the Department of Revenue. Therefore, reliable data for the number of car rentals is available online for years 2010-2018. Travel data is primarily from the 2017 NHTS, which provides average information for car rentals. While some car rental companies have different rental business models (such as primarily renting replacement vehicles while repairs are made to an owner's vehicle), the NHTS is the only data source that is available and citable.

4.5.2. Car Rental Baseline 2018 and 2030 Trips, VMT, and Emissions

The data provided reveals an average of 47,600 daily vehicle rentals per day in 2018. It is unknown how much, on average, a rental car is driven per day. The only known estimate available at the time of research was the 2017 NHTS data that estimated an average of 66 miles per day for those trips reported by car rental or car share. Applying these assumptions, 3.1 million VMT is estimated for car rentals. The amount of emissions associated with car rentals is 1,423 short tons per day of CO_2e.

To forecast car rentals in 2030, the historical data from 2010 to 2018 made available by the Department of Revenue was used to estimate the linear relationship over time for car rentals and resulted in an estimated **76,400 car rentals per day in 2030**. Assuming the same 66 miles per day travel, **5 million VMT is estimated for car rentals in 2030.** The amount of emissions associated with car rentals is 1,526 short tons per day of CO_2e in 2030.

It is currently unknown how many miles a rented car is driven per day in Colorado. Given the uncertainty in average VMT per day, low and high estimates of car rental travel were bracketed by 25-mile (from the average VMT per trip, not per day, obtained from NHTS) and 150-mile (the industry standard maximum) per day assumptions. This results in **ranges of 1.2 to 7 million VMT in 2018 and 1.5 to 12 million VMT in 2030**.

4.6 Residential Delivery

4.6.1. Residential Delivery Data Sources

For the purposes of this analysis, the study focused on third-party restaurant delivery firms, online grocery deliveries, and shippers that deliver goods purchased online. Out of the six modes evaluated in the study, **residential delivery** proved to be the most difficult to obtain reliable, quantifiable data that could be used for the analysis. Attempts were made to solicit information directly from the various market participants, but given the short notice, expedited project schedule, and corporate fears of divulging competitively sensitive market data, no information was provided. Therefore, while every effort was made to make reasonable estimates for the number of residential deliveries and the average trip length for each delivery type, the lack of research and quantifiable data made it very difficult to bracket the estimates with lower and upper boundaries. **Thus, the estimates made for "residential delivery" should be considered as a placeholder until better data is available.**

Third Party Restaurant Delivery

Third-party restaurant delivery firms include companies like DoorDash, Uber Eats, and Grubhub. The business model is one where these firms act as intermediaries between the restaurant and customer. The customer places an order with a participating restaurant on a smartphone application. The firm coordinates with the restaurant to determine a time when the order might be ready. At the same time, delivery drivers are contacted and relayed information on the order. When the order is ready, the delivery driver picks up the order and delivers the food to the customer. The analysis did not try to account for restaurants that provide **direct** deliveries to their customers, such as a small, independent family restaurants or larger restaurant chains. Data sources used to estimate the number of third-party restaurant deliveries included:

- Market share information on the major firms.
- Anecdotal information suggesting an average number of daily orders received.
- Number of restaurants participating in third-party delivery firms in Colorado.

Online Grocery Delivery

Online grocery deliveries can be handled by third-party firms, like Instacart or Shipt, or directly by large grocery retailers with their own employees. These firms process online orders, have employees act as personal shoppers, and deliver the orders to customers. Data sources used to estimate the number of online grocery deliveries made during a day included:

- Anecdotal data on the average distance that most customers travel to their grocery store.
- Number of households in Colorado.
- Average number of trips made to a grocery during a week.
- Current market share of online grocery shopping.

E-Commerce Delivery

The explosive growth in e-commerce has resulted in a commensurate increase in residential deliveries. While the traditional delivery/logistics firms, such as United Parcel Service (UPS), FedEx, and the United States Post Office (USPS), have handled most of the increase, new players like Amazon have also entered the market. Amazon uses UPS, USPS, and other firms to deliver their orders, as well as independent contractors (Amazon Flex and Amazon Delivery Service Partners). Data sources used to estimate the number of residential deliveries associated with e-commerce included:

- 2017 NHTS.[42]
- 2017 study conducted by Dr. Jean-Paul Rodrigue on the parcel delivery market for a large apartment complex.[56]

4.6.2. Residential Delivery Baseline 2018 and 2030 Trips, VMT, and Emissions

Third-Party Restaurant Delivery

There are approximately 4,190 restaurants participating with one of the three major third-party restaurant delivery firms of Grubhub, Uber Eats, DoorDash, and OrderUp in northern Colorado.[49] An assumption was made that restaurants deliver an average of 8 orders per day based on an interview with a restaurant owner. This assumption is less than 10 deliveries per day average provided by the interviewee.[50] Another assumption made was that the firms employ sophisticated algorithms and machine learning to minimize the times and distances driven by the delivery drivers.[51] While the average trip length per delivery most likely shows great variation depending on the location of the customer, the location of the driver when he/she accepts the order, and whether multiple orders are delivered in one delivery trip, a conservative estimate of 5 miles (including deadhead) was assumed for each delivery. **Thus, in 2017, approximately 33,780 third-party restaurant deliveries are made today. Assuming five miles per each delivery, total VMT would be 168,900 for 2018.**

For 2030, a compound annual growth rate of 20% was assumed based on market research conducted by UBS Bank.[52] **This results an estimate of 301,126 residential deliveries and 1,506,630 VMT in 2030**. While this growth assumption is very aggressive, some of the other data used in the estimates provides an offset to very conservative numbers used in the analysis, such as the average trip length. As emphasized earlier, these estimates are "reasonable guesses," and should be considered placeholders until quantifiable data is available since there is considerable uncertainty and many assumptions being made for this analysis.

Online Grocery Delivery

Online grocery delivery estimates were developed based on the assumption that typical trip-making characteristics to a grocery store would also apply to online grocery purchases and deliveries. Using the assumption that households typically make 1.5 trips to the grocery per week,[53] the number of households (2,296,481) in Colorado for 2015 was multiplied by 1.5 trips. Based on these assumptions, there are 3,444,122 grocery trips made in the state during any given week and 492,017 daily grocery trips.

The United States currently lags other developed countries with online grocery purchases at 3%, which suggests approximately 14,760 grocery deliveries, assuming they are all delivered. The average trip length traveled by customers to a grocery store is 4 miles.[54] Assuming this distance would likely be the same distance as driven by an employee in delivering groceries, there would be approximately 118,804 VMT (including deadhead) in 2018. For 2030, the assumption was made that online grocery purchase and deliveries would triple from 3% to 9%, which would still put Colorado behind the United Kingdom and South Korea where some estimates put online grocery spending as high as 15%.[55] Using the 2030 estimates for households in Colorado of 2,950,775 and online grocery purchases at 9%, there would be 56,908 residential grocery deliveries and 341,447 VMT in 2030.

E-Commerce Delivery

Residential deliveries for online shopping were estimated using the 2017 NHTS[42] and research conducted by Dr. John-Paul Rodrigue[62]. The 2017 NHTS data for Colorado suggests 2.37 online purchases per month that were delivered. Converting this monthly figure to a daily value results in 0.095 average deliveries/person/day. For an estimate of 2017 daily residential deliveries, 0.095 was multiplied by the state's 2015 population of 5,452,000, giving an estimate of **517,700 average daily residential deliveries.** For 2030, the assumed annual growth rate was 17% per year for 3 years[56] to 2020. From 2020 to 2030, a flat growth rate was assumed. Using the 2030 population of 6,892,000 persons with Rodrigue's growth rate, there would be 1,048,154 daily **residential deliveries in 2030**.

The major delivery/logistics firms like UPS, FedEx, and Amazon deliver so many packages, they use algorithms to make their deliveries as efficient as possible. Detailed information for UPS was used to estimate UPS miles/package. This metric (UPS miles/package) was used to guide estimates for USPS, FedEx, and Amazon. On average, UPS drivers make 120 deliveries per day.[57] For an estimate of UPS miles per package, UPS' annual miles were divided by the annual number of UPS packages (3,000,000,000[58]/5,200,000,000[59]), which results in 0.58 miles per package. Performing a similar calculation for the USPS, 2018 annual miles were 1,400,000,000[60] with a package volume of 6,200,000,000.[61] Dividing the annual miles by annual package volume is approximately 0.23 miles per package.

Rodrigue's research on parcel delivery in a residential apartment complex was used to estimate VMT by provider.[62] The VMT per package metric described above was used to scale the average number of deliveries. Table 4-2 shows the 2017 and 2030 residential delivery VMT estimates. Note the 2017 and 2030 VMT estimates were increased by 25% to account for the VMT/parcel since they also include commercial deliveries, which one would assume would be more concentrated than residential. Moreover, there was no direct data from the smaller delivery providers (e.g., FedEx, Amazon) which one would also assume to be less efficient than larger providers.

Table 4-2. 2017 and 2030 Residential Delivery VMT Estimates

Delivery Firm	Percent of Parcel Delivery	VMT/Package	2017 VMT	2030 VMT
USPS	47%	0.23	68,679	139,049
UPS	28%	0.58	104,536	211,646
FedEx	11%	0.58	41,068	83,147
Amazon	11%	0.58	41,068	83,147
Other	3%	1.15	22,400	45,353
Total			277,500	562,342

Adding the residential deliveries from third-party restaurant delivery, online grocery delivery, and residential delivery, the total estimate for residential deliveries in 2017 is 566,240. Total VMT for 2017 is 564,734. Emissions associated with residential delivery for 2017 is 255 short tons per day of CO_2e. The reason that the average trip length for residential delivery is so short is because of the scale of the major delivery firms, as well as their efficiency in delivering packages along their routes. In 2030, the estimate for total residential deliveries is 1,406,187. VMT also increases to 2,523,227. The estimate for emissions in 2030 is 776 short tons per day of CO_2e.

4.7 Summary

Any number of social, economic, or regulatory changes could substantially impact any or all of these modes of travel, but it is important to understand how they are operating today and what may lay ahead for these modes, Colorado's residents and visitors, the state's transportation infrastructure, and the environment.

The analyses in this report represent the average daily miles on the road today and their potential by 2030. These efforts have not accounted for a number of factors, including, but not limited to, the following:

- Any miles on the road by these modes that are substitutions for other vehicle travel.
- Any suppressed travel as a result of these options being available.

- Any induced travel as a result of these options being available.
- Any impacts of one mode on another in the future.

Estimates for number of vehicle trips and total VMT per day in 2019 and 2030 are provided by mode in Table 4-3 and Table 4-4.

Table 4-3. 2018 Number of Vehicle Trips and Total VMT Per Day

Travel Metric	Emerging Mobility Mode	Today (2018)			Share of Travel		
		Best Estimate	Low	High	Best Estimate	Low	High
Daily Vehicle Trips	TNCs	63,000	38,000	120,000	0.8%	0.5%	1.6%
	Peer-to-Peer Car Share	100	n/a	10,000	0.0%	n/a	0.1%
	Non-Peer Car Share	1,800	n/a		0.0%	n/a	
	Taxis	5,500	5,500	7,100	0.1%	0.1%	0.1%
	Car Rentals	47,600	47,600	47,600	0.6%	0.6%	0.6%
	Residential Deliveries	n/a	n/a	n/a	n/a	n/a	n/a
	Total Vehicle Trips for Emerging Mobility Services	120,000	90,000	185,000	1.6%	1.2%	2.4%
	Total Vehicle Trips in CO	7,522,000					
Daily VMT	TNCs	743,000	448,000	1,396,000	0.6%	0.4%	1.1%
	Peer-to-Peer Car Share	1,800	n/a	503,000	0.0%	n/a	0.4%
	Non-Peer Car Share	12,800	n/a		0.0%		
	Taxis	53,200	53,200	68,100	0.0%	0.0%	0.1%
	Car Rentals	3,153,000	1,190,000	7,140,000	2.5%	1.0%	5.7%
	Residential Deliveries	564,700	564,700	564,700	0.5%	0.5%	0.5%
	Total VMT for Emerging Mobility Services	4,528,000	2,256,000	9,672,000	3.6%	1.8%	7.8%
	Total Statewide VMT	124,200,000					

Notes: Car Rentals are estimated as daily rentals, not individual trips.
Total Daily Statewide VMT does not include trucks.

Table 4-4. 2030 Number of Vehicle Trips and Total VMT Per Day

Travel Metric	Emerging Mobility Mode	Future (2030)			Share of Travel		
		Best Estimate	Low	High	Best Estimate	Low	High
Daily Vehicle Trips	TNCs	315,000	81,000	850,000	3.4%	0.9%	9.2%
	Peer-to-Peer Car Share	200	0	56,600	0.0%	0.0%	0.6%
	Non-Peer Car Share	2,200	0		0.0%		
	Taxis	6,900	0	8,700	0.1%	0.0%	0.1%
	Car Rentals	76,400	60,600	81,500	0.8%	0.7%	0.9%

Table 4-4. 2030 Number of Vehicle Trips and Total VMT Per Day

Travel Metric	Emerging Mobility Mode	Future (2030)			Share of Travel		
		Best Estimate	Low	High	Best Estimate	Low	High
	Residential Deliveries	n/a	n/a	n/a	n/a	n/a	n/a
	Total Vehicle Trips for Emerging Mobility Services	400,000	140,000	1,000,000	4.3%	1.5%	10.8%
	Total Vehicle Trips in CO	9,224,000					
Daily VMT	TNCs	3,700,000	950,000	10,000,000	2.3%	0.6%	6.3%
	Peer-to-Peer Car Share	3,600	n/a	2,821,000	0.0%	n/a	1.8%
	Non-Peer Car Share	16,000	n/a		0.0%	n/a	
	Taxis	66,700	0	83,400	0.0%	0.0%	0.1%
	Car Rentals	5,060,700	1,515,000	12,225,000	3.2%	1.0%	7.7%
	Residential Deliveries	2,523,000	2,523,000	2,523,000	1.6%	1.6%	1.6%
	Total VMT for Emerging Mobility Services	11,000,000	5,000,000	28,000,000	7.2%	3.1%	17.4%
	Total Statewide VMT	158,268,000					

Notes: Car Rentals are estimated as daily rentals, not individual trips.
Total Daily Statewide VMT does not include trucks.

CHAPTER 5. ANALYSIS OF FEE STRUCTURES

5.1 Fee Structures

Different types of fee structures that are either being planned or are already implemented in a combined 40 cities, airports, and states were reviewed, as seen in the TNC Taxes and Fees spreadsheet in Appendix C. The range of rates for a flat fee per trip for cities and states was $0.10 to $0.72. For example, New Jersey has a $0.50 per ride fee ($0.25 for a shared ride). The rates for a percent of fare (trip transaction) fee for cities and states had a low rate of 1.0% and a higher rate up to 7%. For example, the City of San Francisco is planning to have a 3.25% tax on the fare for single-occupancy rides and 1.5% tax on shared rides or rides in an EV. Several states have conducted studies and pilot projects on mileage-based fees (otherwise known as road usage charges). These rates have varied nationally in the range of $0.012 per mile (Colorado Road User Charge Pilot project)[63] to $0.015 per mile (Oregon's "OReGO" project)[64] and up to $0.018 per mile (California Road Charge Pilot Program).[65] These existing rates in other areas were a referenced when potential fee structures were considered for modeling purposes.

The rates shown in Table 5-1 are examples of a potential vehicle emissions impact fee for Colorado. Future scenarios and rates of fees may be considered. The purpose of providing this example is two-fold. First, the forecasted data for the year 2030 allows a general comparison of a flat fee to a mileage-based fee, and to a percent of transaction fee. Secondly, the forecasted data allows for a statewide assessment of potential revenue under a lower rate of fee structure against a higher rate structure. For the purposes of planning comparisons, an initial set of fees were tested for modeling that generated a range of approximately $10 million to $30 million (2019$, non-discounted) annually in 2030 on TNC single ride trips. The high end of this range is the same order of magnitude as is currently generated by fees on rental cars in Colorado.

Note that there are three potential ride types that produce different rates. The most desirable ride type that reduces the most congestion and carbon emissions is a pooled or shared ride in a ZEV. This has the lowest vehicle emissions impact, and in some cases has no fee. The least desirable ride type is assumed to be a single-occupancy trip in an ICE vehicle, because this is the least efficient in moving people and has higher carbon emissions than an EV. Pooled trips were only able to be estimated for TNCs. The rates were also suggested for simplicity of modeling purposes, and they fit well within the national ranges as discussed above.

Following completion of the stakeholder process, giving strong consideration to the Working Group feedback and the report, CDOT will present recommendations to the Legislature in mid-January 2020. Following the 2020 Legislative Session, CDOT must promulgate rules by October 1, 2020 (see Section □ for next steps for CDOT). It is unknown whether these specific fee structures and rates will be utilized. CDOT will give consideration to feedback from the Working Group with regard to the type and structure of a potential fee.

Based on these considerations, the fee structures presented in Table 5-1 were tested.

Table 5-1. Fee Structure Scenarios for Testing Demand Response and Revenue Generation

Ride Type	Mileage-Based Fee Low	Mileage-Based Fee High	Flat Low	Flat High	% of Transaction Low	% of Transaction High
ICE, Single Occupancy	$0.009	$0.027	$0.106	$0.324	0.8%	2.4%
Shared Ride or ZEV	$0.005	$0.018	$0.053	$0.181	0.3%	1.0%
Shared Ride and ZEV	$0.000	$0.009	$0.000	$0.013	0.0%	0.5%

5.2 Analysis Approach

The impact of fee structures imposed on emerging transportation modes on statewide VMT and revenues was analyzed using an assumed elasticity of demand. This section presents the assumptions underlying this analysis and identifies the circumstances in which they may not reflect reality.

There are some common themes from the literature review that should be noted in the context of this analysis. First, research generally suggests that discretionary (i.e., leisure) trips are more elastic than necessary (i.e., business) trips, though no differentiation between trip types or purposes is made in the analysis on the impact of fee structures. Second, although fuel-efficient and EVs may have an impact on demand for some emerging modes and services, no quantitative evidence was found in the literature to suggest that fuel-efficient or EVs have a significant impact on the likelihood of consumers to take a trip or select a given mode. Finally, there are no studies specifically looking at rural areas, or the difference in demand between rural and urban areas, except when the rural areas are specifically vacation destinations. Thus, no differentiation is made for ZEVs or between rural and urban areas in the estimated impacts of the fee structures.

There is a wide range of elasticities in the literature for the six emerging modes. The differences in the price elasticities across emerging transportation modes from the literature cannot be attributed to the difference in mode alone. There are several factors that are different between any given pair of studies (e.g., time period of data, location of data, controls in the econometric analysis, type of market, etc.), and the difference in elasticities could be partially attributed to these differences. Thus, it cannot concluded, based on the current literature, that there is a significant difference in demand responsiveness to price across these emerging modes. Based on these findings, the analysis uses the same elasticity of demand for all modes to estimate the impact of the fee structures.

A constant elasticity was assumed for this analysis, as there is not enough data in the literature or from the Colorado market to estimate a full demand curve for emerging modes. A constant is a fair representation of demand as long as changes in price from current conditions are relatively small. In reality, the demand elasticity is variable along the demand curve (from relatively higher prices and lower quantities, to relatively low prices and high quantities, the elasticity, or responsiveness of demand with respect to price, will be different). Therefore, under a constant elasticity, the larger the price change with the fee structures, the less accurate estimated change in demand will be.

Estimating the impact of a fee structure on VMT and trips based on an elasticity of demand inherently assumes that customers perceive a price change for transportation by emerging modes under the fee structure as a catalyst for a change in behavior (i.e., the number of trips and VMT). This assumption does not hold if companies do not pass the fee on to the customers.

The analysis assumes that the relative prices (and attractiveness) of modes compared to others remain equal, such that there are no shifts in demand between modes. Including the possibility of shifting VMT and trips between modes is beyond the scope of this analysis, as there is little information on cross-price elasticities between emerging modes to inform the necessary elasticity assumptions. Though fee structures are applied to all modes, the incentives (in lower fees) provided to shared rides and ZEVs violate this assumption. This assumption also does not hold when the flat fee structure is applied to modes that have different magnitudes of fares and prices, or when the mileage-based fee structure is applied to markets and companies with different price-per-mile costs or fares.

Moreover, the analysis does not factor the potential of an increase in prices for emerging technology companies as their business models may evolve.

Finally, the fee structure impact estimation depends on the assumption that trip lengths for each emerging mode will not change with the fee structure—the fare increase will not change the average miles per trip or per shipment for emerging modes. This ensures that the percent change in trips is representative of the resulting percent change in miles. Based on evidence from the travel demand model, it is expected that trip length will decrease with the fee structures, thus the estimated VMT reduction with the fee structures from the elasticity-based analysis will be an underestimate.

Based on professional judgment of the range of elasticities for all emerging modes from the literature, the impact of the fee structures (both high and low fee sets) was estimated under two scenarios:

1) *Demand is more responsive to changes in price*, assuming a relatively more elastic demand for emerging modes (-1.0).

2) *Demand is less responsive to changes in price*, assuming a relatively less elastic demand for emerging modes (-0.3).

Estimating the impact under two types of demand, together with two levels of fees, provides a range of potential impacts on VMT and trips from the fee structure. The highest and lowest estimated impacts are presented in the following sections, by mode.

Appendix H contains further information on sources and assumptions for elasticities.

5.3 Elasticity Literature Synthesis

This section presents the synthesis of literature reviewed on a number of emerging modes of transportation anticipated to impact future travel patterns in Colorado. It contains two sections. The first section presents a summary of the literature review. The literature available is limited; therefore, elasticities were considered from domestic and international studies. Note that the literature review did not consider emerging issues in behavioral economics, such as consumer choice, loss aversion, and reactions to small versus large financial incentives.

5.3.1. Research Summary

TNCs

Cohen et al. (2016)[66] conduct an econometric analysis on a dataset of UberX sessions from San Francisco, New York City, Chicago, and Los Angeles, from six months of 2015, to estimate elasticities of demand (purchase rate) with respect to the surge price. (UberX, the app-based ride hailing service, uses real-time pricing (surge pricing) based on local market conditions to equilibrate short-term supply and demand. Surge pricing is a multiplier that increases the fare of an UberX ride up to 5 times higher than the base price.) The demand elasticity estimated across all geographies and all time periods is -0.5, with controls for differences in wait time. Demand elasticities estimated for specific time periods range from -0.46 to -0.66. Elasticities estimated for different price levels range from -0.25 to -1.01 (surge prices in the dataset ranged from 1.0x (no surge) to 5.0x). These elasticities may underestimate the impact of rider response to a long-term statewide price change because the study is based on a relatively short time period of short-term, location-specific price variations.

Car Share (Peer-to-Peer and Non Peer)

Many studies do not differentiate between car-sharing programs, ridesharing services, and taxi services. There are very few papers that address one mode without the others. Carterni et al. (2006)[67] conducted an econometric analysis on stated preference survey data from a park-and-share service in which people drive to a parking lot and peer-to-peer car share to enter the city center of Salerno in southern Italy. The study estimates a demand elasticity of -0.85, which implies an 8.5% decrease in trips demanded resulting from a 10% increase in price. In comparison, a review of existing literature on peer-to-peer transport services (including taxi and rideshare services) published by Copenhagen Economics in 2015 uses an own price elasticity of -1.4 for ridesharing with a single passenger, and an elasticity of -1.0 for ridesharing with two or more passengers.[68]

Taxis

Rose and Hensher (2014)[69] use state choice survey data from 2012 and econometric analysis to simulate changes in mode choice in response to a change in taxi fare in Melbourne, Australia, for different types of trip purposes and riders. The estimated elasticities of demand range from -0.6 to -1.5 with a weighted average elasticity of -1.0. The authors estimate elasticities for business trips and day-to-day activities at -0.65 and -0.75 respectively. Responses are estimated based on a 10% change in taxi fares.

Several other studies on the subject of the price elasticity and demand for taxi services are summarized in Table 5-2 from the literature review by Rose and Hensher (2014)[69]. Many studies, however, were conducted on data that represent markets without TNCs. Without the potential competition for door-to-door ride-hailing services, the elasticities may imply an inelastic demand for taxi services that may no longer apply.

Table 5-2. Taxi Demand Elasticities with Respect to Fare

Study*	Location	Data	Elasticity Measure	Market	Price Elasticity
Schaller (1999)	New York, USA	Time series (1990-1996)	Revenue Measure		-0.22
Flores-Guri	New York, USA	Time Series (1990-1999)	Kilometer Driven		-1.05
Toner (2010)	Four UK Cities	Stated Preference/ Transfer Price	Number of Trips		-1.00
Rouwendal et al. (1998)	The Netherlands	Stated Preference (1997)	Number of Trips	All taxi users	-1.14
				Business	-0.76
				Going out	-1.75

Table 5-2. Taxi Demand Elasticities with Respect to Fare

Study*	Location	Data	Elasticity Measure	Market	Price Elasticity
				Going to the railway station	-0.69
Beesley (1979)	London, UK	Time series (1951-1952)	Kilometers Driven		-0.35
Wong (1971) cited in Frankena and Pautler (1984)	Washington D.C., USA	N/A	Number of trips		-1.40
Applied Economics Associates (1978) cited in Frankena and Pautler (1984)	Seattle, USA	N/A	Number of trips		-1.00
Kitch et al. (1979) cited in Frankena and Pautler	Chicago, USA	N/A	Number of Trips		-0.80
McGillivray (1979), cited in Frankena and Pautler (1984)	Danville, USA	Time series (1975-1977)	Number of Trips		-0.60
Brown and Fitzmaurice (1978) cited in Frankena and Pautler (1984)	21 cities, USA	N/A	Number of trips		-0.80
Orfeuil and Hivert (1989), cited in BITRE Database	Paris, France	N/A	N/A		-0.50
Queensland Transport (2000)	Queensland, Australia	N/A	Number of Trips	Brisbane	-0.36
				Other Cities	-0.50
Booz Allen Hamilton (2003)	Canberra, Australia	Stated Preference (2002)	Number of Trips	All taxi users	-0.36
				Peak hour	-0.23
				Off peak	-0.41

These studies are all cited in the literature review by D Hensher and J Rose, "Demand for Taxi Services: New Elasticity Evidence," Transportation 41, no. 4 (2014): pp. 717-743 (2014).

Car Rental

Most of the demand elasticities for rental cars found in the literature refer to the duration of the car rental demanded with respect to the price of the car rental. Menezes and Uzagaliveva (2013)[70] and Palmer-Tous et al. (2007)[71] estimate a relatively inelastic demand for car rentals (-0.36 and -0.34 respectively); however, they are both based on survey data from island tourist destinations. The demand for car rentals at airports and tourist destinations is expected to be fairly inelastic, but may not be representative of overall demand for car rentals in an urban inland U.S. city with readily available substitutes for transportation. Anderson et al. (2004)[72] assume a very inelastic demand elasticity of -0.07 with respect to price for economy cars rented at Denver International Airport in a computational model of competitive car rental pricing for revenue management.

Retail Goods and Shipment of Retail Goods

Okrent and Alston (2012)[73] estimate elasticities for "food purchased away from home" at full-service or limited-service restaurants using U.S. survey data from 1998 to 2010. They found that demand for limited-service restaurants is almost perfectly inelastic to changes in prices (-0.13), and demand for meals from full-service restaurants is quite price elastic (-1.96). Additionally, Andreyeva et al. (2010)[74] reviewed prior U.S.-based studies on the price elasticity of demand for major food categories from 1938 to 2007 to determine mean price elasticities for "food purchased away from home" by category and assess variations in estimates by study design. The authors found that the price elasticity estimate range is -0.23 to -1.76. Even if these findings can be used as a proxy, they imply that the elasticity of demand for carry-out or take-away food purchases may vary widely.

A literature review was completed on freight shipments as a proxy for the elasticity of demand for the shipment of retail goods. A Victoria Transport Policy Institute review of transport elasticities includes some studies on freight transport and shipment. Thomas Bue Bjørner (1999) estimates the price elasticity of freight transport (measured in ton-miles) in Denmark to be -0.47.[75] The elasticity of freight traffic (measured in truck-kilometers) is -0.81, and the elasticity of freight energy consumption is only about -0.1. A 10% increase in shipping costs leads to a decrease in truck traffic by 8%; however, total shipping volume decreases by only 5%, as some of the freight is diverted to rail, while other freight is shipped using existing truck capacity more efficiently. Hagler Bailly (1999) estimate the long-run price elasticity of rail and truck freight transport at -0.4, with a wide range depending on the type of freight.[76] Small and Winston (1999) summarize various estimates of freight elasticities.[77] These are presented in Litman (2019)[78] and reported in Table 5-3.

Table 5-3. Freight Transport Elasticities

Variable	Rail	Truck
Aggregate Mode Share Model, Price	-0.25 to -0.35	-0.25 to -0.35
Aggregate Mode Share Model, Transit Time	-0.30 to -0.70	-0.30 to -0.70
Aggregate Mode from Tanslog Cost Function, Price	-0.37 to -1.16	-0.58 to -1.81
Disaggregate Mode Choice Model, Price	-0.08 to -2.68	-0.04 to -2.97
Disaggregate Mode Choice Model, Transit Time	-0.07 to -2.33	-0.15 to -0.69

Source: Litman (2019), page 57.
Note: These elasticities vary depending on commodity groups.

Evidence on Amazon and Other Online Shopping Platforms

Amazon and other online shopping platforms have significantly altered the market for purchase and shipment of retail goods. Currently, it appears that customers are relatively price inelastic to services like Amazon (or perhaps Amazon itself). According to a *Medium* news article, Amazon Prime memberships in Spain increased even though membership prices increased, because customers seem to accept the price increase in favor of the advantages of the subscription.[79]

Similarly, Houde et al (2017)[80] (a working paper) find that "mean preferences" for Amazon, relative to the offline shipping mode, increase steadily from 2006 to 2013, whereas preference for other online shipping modes was relatively constant. The authors find little evidence that a new fulfillment center leads to an increase in demand for Amazon. Goolsbee and Chevalier (2003)[81] analyze and compare book sales from Barnes and Nobles and Amazon from 2001 and find that Amazon has a relatively small own-price elasticity (-0.5) and a large cross-price elasticity (demand with respect to Barnes & Noble prices).

Einav et al. (2014)[82] estimate customers' sensitivity to shipment costs, and find that "consumers are twice as sensitive to distance when it affects the shipping fee" (page 11). They find that the average variable rate shipping fee increases by around $0.56 for every doubling in distance, and a $0.56 increase in the shipping fee corresponds to a -1.1 price elasticity. Their analysis also provides a tax-price elasticity of -1.7 (page 9).

5.4 Results

This section presents the results of the application of elasticities derived from the literature review to estimate changes in VMT and revenues in response to fee structures imposed on these transportation modes. The results apply a fee structure for planning comparison that approximates low annual revenue of $10 million and a high annual revenue of $30 million for TNC single rides (a manually "normalized" fee structure across structure types and vehicle types). The assumed fleet in 2030 incorporates the portions of ICE vehicles and ZEVs, based on the Colorado Energy Office study[38]. The tiered discounts (proportional to the ICE fee) for pooled rides and/or ZEVs were applied. This fee structure is assumed for all modes.

5.4.1. TNC Fee Structures and Revenue Estimation

For the estimation of fee structure impacts on VMT and trips by TNCs, VMT and trips are estimated for "pooled" rides and "single" rides. Pooled rides are those in which different passengers are picked up and dropped off en route during a TNC trip. In effect, the passengers share the TNC vehicle trip with other passengers. Pooled rides are assumed to comprise 13% of VMT and trips by TNCs, based on a dataset of UberX, Lyft, UberPool, and LyftLine ride-hailing trips from Denver used in a study by Henao and Marshall (2018).[10] The base fare for pooled rides is assumed discounted 70% from single rides. Together with the base fare averaged across all TNC ride types ($13.08 per trip), the base fare for single and pooled rides is calculated. For TNC single rides, the "ICE, single occupancy" fee structure is applied. For TNC pooled rides, the "shared ride or ZEV" fee structure is applied.

The analysis assumes that the mileage-based fee is applied on all vehicle-miles (including deadheading, although this may be administratively complicated to implement), the flat fee is applied to each vehicle trip, and the percentage-based fee is applied as a percent of the trip fare. For the mileage-based fee structure, the fee on vehicle-miles is combined with the average vehicle-miles per trip (calculated from the VMT and trip data) to generate an estimate of the fee per trip.

For each fee structure, the percentage change in fare is calculated from the trip fare with and without the fee, and multiplied by the elasticity (for more responsive and less responsive demand scenarios) to estimate a percent change in demand. Daily trips and daily VMT under the fee structure are calculated from the percent change in demand (because the analysis assumes the average length per trip remains the same).

Under the mileage-based fee structure, revenue is calculated as a simple product of the VMT under the fee structure and the fee per vehicle-mile. Revenue from the flat fee structure is a product of the trips under the fee structure and the fee per vehicle-trip. Percentage-based fee structure revenue is a product of trips under the fee structure and the fee per vehicle trip (calculated as a percent of the base trip fare).

Emissions are assumed to decrease proportionately with VMT under the fee structure. Reduced emissions in 2030 are monetized based on dollar values for the Social Cost of Carbon (per metric ton of CO_2) from the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2018), inflated to 2019 dollars.[83]

2030 Trips, VMT and Emissions

The resulting impacts from the three fee structures on TNC single rides and TNC pooled rides are presented in Table 5-4 and Table 5-5. At the low end, the estimated impact is represented by the low fee structure combined with the less responsive demand scenario. Alternately, the high end of the estimated impact is represented by the high fee structure combined with the more responsive demand. The results of the low fees with the more responsive demand and the high fees with the less responsive demand lie within this range. The results (trips, VMT, revenue, and emissions) are all daily measures.

For TNC rides (pooled and single), the largest reduction in VMT is induced by the flat fee structure, driven by the corresponding percent increase in the base fare of TNC rides. The flat fee structure also provides the most revenue dollars, relative to the other fee structures.

Table 5-4. Results of Fee Structure Impact on TNC Single Rides in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	273,185	267,056	273,185	266,973	273,177	267,029
VMT (Daily)	3,198,006	3,126,260	3,198,009	3,125,289	3,197,921	3,125,945
Percentage Change from 2030 Baseline	-0.22%	-2.46%	-0.22%	-2.49%	-0.22%	-2.47%
CO2e Daily Emissions (tons)	874	854	874	853	874	853
Annual Revenue for 2030 (2019$, undiscounted)	$9,986,705	$29,660,506	$9,982,309	$30,009,188	$10,105,739	$29,756,155

Low-End Impact comprises the Low Fees & Less Responsive Demand
High-End Impact comprises the High Fees & More Responsive Demand

Table 5-5. Results of Fee Structure Impact on TNC Pooled Rides in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	40,844	39,971	40,850	40,144	40,878	40,486
VMT (Daily)	478,136	467,919	478,210	469,946	478,537	473,944

Table 5-5. Results of Fee Structure Impact on TNC Pooled Rides in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Percentage Change from 2030 Baseline	-0.16%	-2.30%	-0.15%	-1.87%	-0.08%	-1.04%
CO2e Daily Emissions (tons)	131	128	131	128	131	129
Annual Revenue for 2030 (2019$, undiscounted)	$775,580	$2,901,718	$702,401	$2,374,094	$379,203	$1,329,781

Low-End Impact comprises the Low Fees & Less Responsive Demand
High-End Impact comprises the High Fees & More Responsive Demand

5.4.2. Peer-to-Peer Car Share Fee Structures and Revenue Estimation

For the estimation of fee structure impacts on VMT and trips by peer-to-peer car share, the "ICE, single occupancy" fee structure is assumed, and daily vehicle-trips represent car share reservations per day. For peer-to-peer car share, even less is known about the average costs per reservation. Vehicle owners that make their vehicles available on a peer car-sharing platform can set their prices based on their vehicle type, time of day, day of the year, etc. Considering that these services are similar to the Zipcar model, in that you need to return the vehicle to the same spot it was picked up at, the $15.54 cost per day for a 15-mile average trip length per day was assumed.

The analysis assumes that the mileage-based fee is applied on all vehicle-miles, the flat fee is applied per day and per reservation, and the percentage-based fee is applied as a percent of the daily reservation cost. For the mileage-based fee structure, the fee on vehicle-miles is combined with the average vehicle-miles per reservation-day (calculated from the base VMT and trip data) to generate an estimate of the fee per reservation per day.

For each fee structure, the percentage change in fare is calculated from the daily fare with and without the fee, and multiplied by the elasticity (for more responsive and less responsive demand scenarios) to estimate a percent change in demand. Daily trips (reservations per day) and daily VMT under the fee structure are calculated from the percent change in demand (because the analysis assumes the average length per reservation-day remains the same).

Under the mileage-based fee structure, revenue is calculated as a simple product of the VMT under the fee structure and the fee per vehicle-mile. Revenue from the flat fee structure is a product of the reservations per day under the fee structure and the fee per reservation per day. Percentage-based fee structure revenue is a product of reservation-days under the fee structure and the fee per reservation per day (calculated as a percent of the base daily reservation cost).

Emissions are assumed to decrease proportionately with VMT under the fee structure. Reduced emissions in 2030 are monetized based on dollar values for the Social Cost of Carbon (per metric ton of CO_2) from the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2018), inflated to 2019 dollars. [83]

2030 Trips, VMT and Emissions

The resulting impacts from the three fee structures on peer-to-peer car share are presented in Table 5-6. At the low end, the estimated impact is represented by the low fee structure combined with the less responsive demand scenario. Alternately, the high end of the estimated impact is represented by the high fee structure combined with the more responsive demand. The results of the low fees with the more responsive demand and the high fees with the less responsive demand lie within this range. The results (reservations, VMT, revenue, and emissions) are all daily measures.

For peer-to-peer car share, the largest reduction in VMT is induced by the flat fee structure, driven by the corresponding percent increase in the daily cost of reservations. The flat fee structure also provides the most revenue dollars, relative to the other fee structures. However, overall the levels are very low, and the percentages of statewide measures are essentially negligible.

Table 5-6. Results of Fee Structure Impact on Peer-to-Peer Car Share in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	199	193	200	196	200	195
VMT (Daily)	3,589	3,481	3,593	3,521	3,592	3,511
Percentage Change from 2030 Baseline	-0.30%	-3.31%	-0.19%	-2.18%	-0.22%	-2.47%
CO2e Daily Emissions (tons)	1	1	1	1	1	1
Annual Revenue for 2030 (2019$, undiscounted)	$11,208	$33,020	$7,294	$21,992	$8,424	$24,804

Low-End Impact comprises the Low Fees & Less Responsive Demand
High-End Impact comprises the High Fees & More Responsive Demand

5.4.3. Non-Peer Car Share Fee Structures and Revenue Estimation

For the estimation of fee structure impacts on VMT and trips by non-peer car share, the "ICE, single occupancy" fee structure is assumed, and daily vehicle-trips represent car share reservations per day. For non-peer car share, the two main providers are SHARE NOW (formerly car2go) and Zipcar. Analyses indicate that the two business models could have different average uses: car2go lending itself to shorter trips and Zipcar to longer trips. For SHARE NOW, with an assumed 6.9 miles for an average trip length, this equates to, roughly, a 20-minute trip. According to the recent published costs for SHARE NOW in Denver, a 20-minute trip costs $8.99,[84] the assumed cost here for the average SHARE NOW rental. Weighting the average trip lengths and costs for SHARE NOW (approximately 1,700 trips) and Zipcar (approximately 50) rentals, the average cost and trip length for non-peer car share trips was assumed to $8.97 and a 6.9-mile trip. .

The analysis assumes that the mileage-based fee is applied on all vehicle-miles, the flat fee is applied per day and per reservation, and the percentage-based fee is applied as a percent of the daily reservation cost. For the mileage-based fee structure, the fee on vehicle-miles is combined with the average vehicle-miles per reservation-day (calculated from the base VMT and trip data) to generate an estimate of the fee per reservation per day.

For each fee structure, the percentage change in fare is calculated from the daily fare with and without the fee, and multiplied by the elasticity (for more responsive and less responsive demand scenarios) to estimate a percent change in demand. Daily trips (reservations per day) and daily VMT under the fee structure are calculated from the percent change in demand (because the analysis assumes the average length per reservation-day remains the same).

Under the mileage-based fee structure, revenue is calculated as a simple product of the VMT under the fee structure and the fee per vehicle-mile. Revenue from the flat fee structure is a product of the reservations per day under the fee structure and the fee per reservation per day. Percentage-based fee structure revenue is a product of reservation-days under the fee structure and the fee per reservation per day (calculated as a percent of the base daily reservation cost).

Emissions are assumed to decrease proportionately with VMT under the fee structure. Reduced emissions in 2030 are monetized based on dollar values for the Social Cost of Carbon (per metric ton of CO_2) from the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2018), inflated to 2019 dollars.[83]

2030 Trips, VMT, and Emissions

The resulting impacts from the three fee structures on non-peer car share are presented in Table 5-7. At the low end, the estimated impact is represented by the low fee structure combined with the less responsive demand scenario. Alternately, the high end of the estimated impact is represented by the high fee structure combined with the more responsive demand. The results of the low fees with the more responsive demand and the high fees with the less responsive demand lie within this range. The results (reservations, VMT, revenue, and emissions) are all daily measures.

For non-peer car share, the largest reduction in VMT is induced by the flat fee structure, driven by the corresponding percent increase in the daily cost of reservations. The flat fee structure also provides the most revenue dollars, relative to the other fee structures.

Table 5-7. Results of Fee Structure Impact on Non-Peer Car Share in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	2,195	2,141	2,193	2,117	2,195	2,146
VMT (Daily)	18,356	17,909	18,338	17,704	18,359	17,946
Percentage Change from 2030 Baseline	-0.24%	-2.67%	-0.34%	-3.78%	-0.22%	-2.47%
CO2e Daily Emissions (tons)	5	5	5	5	5	5
Annual Revenue for 2030 (2019$, undiscounted)	$57,322	$169,908	$80,117	$237,873	$53,472	$157,448

Table 5-7. Results of Fee Structure Impact on Non-Peer Car Share in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact

Low-End Impact comprises the Low Fees & Less Responsive Demand
High-End Impact comprises the High Fees & More Responsive Demand

5.4.4. Taxi Fee Structures and Revenue Estimation

For the estimation of fee structure impacts on taxi VMT and trips, the "ICE, single occupancy" fee structure is applied. The analysis assumes that the mileage-based fee is applied on all vehicle-miles (including deadheading), the flat fee is applied to each vehicle trip, and the percentage-based fee is applied as a percent of the trip fare. For the mileage-based fee structure, the fee on vehicle-miles is combined with the average vehicle-miles per trip (calculated from the VMT and trip data) to generate an estimate of the fee per trip.

For each fee structure, the percentage change in fare is calculated from the trip fare with and without the fee, and multiplied by the elasticity (for more responsive and less responsive demand scenarios) to estimate a percent change in demand. Daily trips and daily VMT under the fee structure are calculated from the percent change in demand (because the analysis assumes the average length per trip remains the same).

Under the mileage-based fee structure, revenue is calculated as a simple product of the VMT under the fee structure and the fee per vehicle-mile. Revenue from the flat fee structure is a product of the trips under the fee structure and the fee per vehicle-trip. Percentage-based fee structure revenue is a product of trips under the fee structure and the fee per vehicle trip (calculated as a percent of the base trip fare).

Emissions are assumed to decrease proportionately with VMT under the fee structure. Reduced emissions in 2030 are monetized based on dollar values for the Social Cost of Carbon (per metric ton of CO_2) from the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2018), inflated to 2019 dollars.[83]

2030 Trips, VMT, and Emissions

The resulting impacts from the three fee structures on travel by taxi services are presented in Table 5-8. At the low end, the estimated impact is represented by the low fee structure combined with the less responsive demand scenario. Alternately, the high end of the estimated impact is represented by the high fee structure combined with the more responsive demand. The results of the low fees with the more responsive demand and the high fees with the less responsive demand lie within this range. The results (trips, VMT, revenue, and emissions) are all daily measures.

For taxi rides, the largest reduction in VMT is induced by the flat fee structure, driven by the corresponding percent increase in the base trip fare. The flat fee structure also provides the most revenue dollars, relative to the other fee structures.

Table 5-8. Results of Fee Structure Impact on Taxis in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	6,891	6,804	6,890	6,782	6,885	6,730
VMT (Daily)	66,617	65,771	66,599	65,561	66,551	65,053
Percentage Change from 2030 Baseline	-0.12%	-1.39%	-0.15%	-1.71%	-0.22%	-2.47%
CO2e Daily Emissions (tons)	18	18	18	18	18	18
Annual Revenue for 2030 (2019$, undiscounted)	$208,034	$624,086	$251,753	$762,486	$371,324	$1,093,356

Low-End Impact comprises the Low Fees & Less Responsive Demand
High-End Impact comprises the High Fees & More Responsive Demand

5.4.5. Car Rental Fee Structures and Revenue Estimation

For the estimation of fee structure impacts on VMT and trips by car rentals, the "ICE, single occupancy" fee structure is assumed, and daily vehicle-trips represent car rental reservations per day. Base fare is represented by $60.85 per day per reservation.

The analysis assumes that the mileage-based fee is applied on all vehicle-miles, the flat fee is applied per day and per reservation, and the percentage-based fee is applied as a percent of the daily reservation cost. For the mileage-based fee structure, the fee on vehicle-miles is combined with the average vehicle-miles per reservation-day (calculated from the base VMT and trip data) to generate an estimate of the fee per reservation per day.

For each fee structure, the percentage change in fare is calculated from the daily fare with and without the fee, and multiplied by the elasticity (for more responsive and less responsive demand scenarios) to estimate a percent change in demand. Daily trips (reservations per day) and daily VMT under the fee structure are calculated from the percent change in demand (because the analysis assumes the average length per reservation-day remains the same).

Under the mileage-based fee structure, revenue is calculated as a simple product of the VMT under the fee structure and the fee per vehicle-mile. Revenue from the flat fee structure is a product of the reservations per day under the fee structure and the fee per reservation per day. Percentage-based fee structure revenue is a product of reservation-days under the fee structure and the fee per reservation per day (calculated as a percent of the base daily reservation cost).

Emissions are assumed to decrease proportionately with VMT under the fee structure. Reduced emissions in 2030 are monetized based on dollar values for the Social Cost of Carbon (per metric ton of CO_2) from the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2018), inflated to 2019 dollars.[83]

2030 Trips, VMT, and Emissions

The resulting impacts from the three fee structures on car rental travel are presented in Table 5-9. At the low end, the estimated impact is represented by the low fee structure combined with the less responsive demand scenario. Alternately, the high end of the estimated impact is represented by the high fee structure combined with the more responsive demand. The results of the low fees with the more responsive demand and the high fees with the less responsive demand lie within this range. The results (reservations, VMT, revenue, and emissions) are all daily measures.

For car rentals, the largest reduction in VMT is induced by the percentage fee structure. This differs from the other modes because the base daily reservation fare is significantly higher than the base fares of other modes, so the flat fee does not represent as high an increase in cost as the percentage-based fee. Correspondingly, the percentage-based fee structure also provides the most revenue dollars for this mode, relative to the other fee structures.

Table 5-9. Results of Fee Structure Impact on Car Rentals in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	76,187	74,021	76,362	75,974	76,229	74,514
VMT (Daily)	5,046,559	4,903,135	5,058,202	5,032,511	5,049,397	4,935,748
Percentage Change from 2030 Baseline	-0.28%	-3.11%	-0.05%	-0.56%	-0.22%	-2.47%
CO2e Daily Emissions (tons)	1,380	1,339	1,383	1,376	1,380	1,347
Annual Revenue for 2030 (2019$, undiscounted)	$15,759,150	$46,514,857	$2,790,446	$8,543,550	$12,603,353	$37,110,334

Low-End Impact comprises the Low Fees & Less Responsive Demand
High-End Impact comprises the High Fees & More Responsive Demand

5.4.6. Residential Delivery Fee Structures and Revenue Estimation

The emerging mode designated as “residential delivery” incorporates several types of final-product delivery services, including app-based food delivery, web-based grocery delivery, online shopping delivery, and generic package shipment services. Each service has a different shipping cost model, which may be weight and/or distance-based, a flat fee, or an annual membership. The wide variety of shipment cost models within this category make it infeasible to generate an average base delivery charge that is a fair representation of all residential delivery suppliers’ fees charged to customers. Because the impacts of the mileage-based and flat fee structures are computed from an assumed base fare or cost, impacts from these fee structures are not estimated. Additionally, fee revenue is not estimated under the percentage-fee structure, as revenue.

For the estimation of fee structure impacts on VMT and trips attributed to residential deliveries, the “ICE, single occupancy” fee structure is applied, and the analysis assumes that the percentage-based fee is applied as a percent of the delivery fee (that which is charged to the customer). The delivery fee (not the product price) was used for this analysis. The percentage change in the delivery fee (represented by the fee percentage) is multiplied by the elasticity (for more responsive and less responsive demand scenarios) to estimate a percent change in demand. Daily trips and daily VMT under the fee structure are calculated from the percent change in demand (because the analysis assumes the average length per trip remains the same).

Emissions are assumed to decrease proportionately with VMT under the fee structure. Reduced emissions in 2030 are monetized based on dollar values for the Social Cost of Carbon (per metric ton of CO_2) from the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2018), inflated to 2019 dollars.[83]

2030 Trips, VMT, and Emissions

The resulting impacts from the percentage-based fee structure on travel attributed to residential deliveries are presented in Table 5-10. At the low end, the estimated impact is represented by the low fee structure combined with the less responsive demand scenario. Alternately, the high end of the estimated impact is represented by the high fee structure combined with the more responsive demand. The results of the low fees with the more responsive demand and the high fees with the less responsive demand lie within this range. The results (trips, VMT, revenue, and emissions) are all daily measures.

Though impacts of the mileage-based and flat fee structures are not estimated, it may inferred, based on the results from the other emerging modes, that the smaller the delivery cost to which the fee is applied, the greater the impact of the flat fee will be relative to the percentage-based fee.

Table 5-10. Results of Fee Structure Impact on Residential Delivery in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	n/a	n/a	n/a	n/a	1,403,046	1,371,467
VMT (Daily)	n/a	n/a	n/a	n/a	2,517,592	2,460,927
Percentage Change from 2030 Baseline	n/a	n/a	n/a	n/a	-0.22%	-2.47%
CO2e Daily Emissions (tons)	n/a	n/a	n/a	n/a	688	672
Annual Revenue for 2030 (2019$, undiscounted)	n/a	n/a	n/a	n/a	n/a	n/a

Low-End Impact comprises the Low Fees & Less Responsive Demand
High-End Impact comprises the High Fees & More Responsive Demand

5.5 Summary

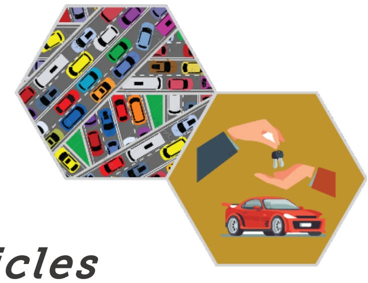
Of the three fee structures, the flat fee structure induces the largest reduction in VMT and emissions, based on the fee levels chosen for modeling. Overall, the flat fee structure reduces the VMT of emerging modes in 2030 by 0.9 to 7.8% (based on the low- and high-end impacts). This reduction corresponds to less than 1% of 2030 statewide VMT. The percent-based fee structure reduces 2030 emerging mode VMT by 0.9 to 4.9%, and the percent-based fee structure reduces this VMT by 0.2 to 1.2%. Table 5-11 presents the results of the fee structure impacts on all emerging modes. Of course, these impacts could differ if higher or lower fees were selected for each fee structure type. Note that the selected fee levels are quite different among the three mechanisms, so this modeling does not allow a conclusion that flat fees are more effective.

Table 5-11. Results of Fee Structure Impact of All Emerging Modes in 2030

	Mileage-Based Fee		Flat Fee		Percentage-Based Fee	
	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact	Low-End Impact	High-End Impact
Trips (Daily)	1,805,688	1,796,374	1,805,866	1,798,373	1,802,611	1,762,566
VMT (Daily)	11,334,490	11,107,701	11,346,179	11,237,760	11,331,949	11,083,074
Percentage Change from 2030 Baseline	0	0	0	0	-0.22%	-2.41%
CO2e Daily Emissions (tons)	3,099	3,034	3,102	3,071	3,098	3,025
Annual Revenue for 2030 (2019$, undiscounted)	$26,797,999	$79,904,095	$13,814,320	$41,949,183	$23,521,515	$69,471,877

These total values include unimpacted residential delivery numbers.

CHAPTER 6. FINDINGS OF THE SUBCOMMITTEES



The recommendations from the six subcommittees that were provided to the Working Group are included in this chapter. The full reports can be found in Appendix I.

6.1 Incentivizing Zero-Emission Vehicles Subcommittee

Because the SB19-239 Stakeholder Working Group was charged with addressing the question of how a fee structure could be used to support electrification, the Incentivizing ZEVs Subcommittee examined this topic and came to the following core recommendations regarding a potential fee structure.

A. Approach to Hybrid Electric Vehicles: There was a debate among the Subcommittee participants as to whether the fee should also be waived or discounted for hybrid electric vehicles and other low-emission vehicles. While the group was unable to come to a consensus, a summary of the arguments pro and con is in the full Subcommittee report included in Appendix K.

B. Fare Transparency: Transportation providers should provide clear transportation cost estimates to riders at all times. Fare estimates should show the price difference between the cost of a trip in an ICE vehicle versus a ZEV to allow the user to make an informed decision.

C. Periodic Reassessment: Assuming that the fee is waived or reduced for ZEV trips, the policy should include an appropriate cap, sunset date, or periodic reassessment to address the long-term revenue impacts of commercial fleet electrification.

D. Waived Fee for ZEVs: To accelerate the adoption of ZEVs in Colorado, any proposed fee for commercial vehicle trips should be waived for trips completed in a ZEV. ZEVs provide significant air quality and climate benefits, and for this reason, the deployment of ZEVs in commercial fleets should be promoted instead of discouraged.

6.1.1. Recommended Additional Tools & Strategies

Expanded Fast Charging Network

Description: A robust network of fast charging stations would help to alleviate EV range anxiety and address geographic limitations. New fast charging hubs should be located at popular destinations, natural break locations, and pick-up/drop-off spots for TNCs, and siting should be coordinated with local governments and utilities to minimize infrastructure costs. A percentage of charging ports should be reserved for fleet charging to minimize wait times for drivers. Charging operators may coordinate with mobility service providers to institute a 'charger reservation system' to ensure that charging ports are available at certain times of the day for commercial vehicle use. Fast charging stations should deliver a minimum of 50kW of electricity, and the electrical infrastructure should be future-proofed to deliver 350kW or more of electricity to accommodate future improvements in charging technologies.

Barriers Addressed: Limited Access to EV Charging Stations, Limited EV Model Availability and Vehicle Range, High Cost of Fast Charging

Challenges: A typical DC Fast Charging station costs $50,000-$100,000 and installation requires coordination between utilities, site owners, EV charging providers, and the users. In addition, dedicating a portion of EV charging stations for fleet drivers may limit charging services for non-fleet vehicles.

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

Home-Charger Incentives and Installation Services

Description: Home-charging is the most convenient and low-cost option for recharging an EV. A home-charger incentive program might include rebates to cover the cost of installing a charging station, as well as services to help drivers navigate the charger installation process. Access to home-charging reduces the reliance on public fast charging, which is more expensive and may result in a higher opportunity cost from the downtime spent charging instead of providing mobility services. Home-charger installations are less complicated for drivers living in single-family homes with a dedicated off-street parking space, and more challenging for drivers who are renters or residents of multi-unit dwellings. The home-charger incentive program should coordinate with utilities to address the financial and logistical challenges of installing charging stations at multi-unit dwellings, where many TNC and taxi drivers live. Owner of long-range battery-electric vehicles (BEVs) with higher daily VMT should be advised to install a Level 2 home-charger, and owners of lower-range plug-in hybrid electric vehicles (PHEVs) may only need a Level 1 charging station.

Barriers Addressed: Limited Access to EV Charging Stations, High Cost of Fast Charging

Challenges: Many drivers live in multi-unit dwellings where home-charging is limited and installations are costly and logistically challenging. A large percentage of TNC drivers are part-time temporary contractors. To the extent possible, incentives should be directed toward long-term contractors to maximize the benefits of the home-charger incentive program. Transportation providers should collaborate with utilities and homeowner associations to develop a standard process for home-charger installations at multi-unit dwellings.

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	No	Yes	No	No

Community Charging Hubs

Description: The Community Charging Hub model provides shared EV charging spaces for commercial fleet vehicles. Community charging hubs should be conveniently located in multi-family neighborhoods where there is a high concentration of commercial drivers. Community charging hubs have the potential to increase charger utilization by offering greater operational flexibility across a variety of use cases. Since the majority of commercial EVs will recharge overnight, it may be possible for commercial EV drivers to share charging stations with day-time parking facilities such as office, retail, and mixed-use parking, and alternate charging sessions with those vehicles on a 24-hour cycle. By installing the charging stations in the public domain instead of residences, the program can reduce the risk of stranded assets.

Barriers Addressed: Limited Access to EV Charging Stations, High Cost of Fast Charging

Challenges: Community charging hubs are complex because they require coordination between a number of different stakeholders. In addition, the community charging hub model requires drivers to commute to the charger location, which adds an opportunity cost, and potentially, additional VMT to the system.

Example: Xcel Energy Minnesota "community charging hub" pilot program.

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	No	No

Free or Discounted Fast Charging

Description: The cost of fast charging is typically much higher than that of home-charging, and these higher rates can negate the economic benefits of driving an EV. The average TNC or taxi vehicle drives significantly more miles per year than a personally owned vehicle and as a result, the fuel costs are a more important factor in the vehicle selection process. By guaranteeing free or low-cost electricity for fleet drivers, the program can make EVs the more attractive vehicle option, particularly in the context of the short-term rental program. Charging discounts or rebates might be designed to cover the full energy costs or the incremental cost of charging an EV at a fast charging station versus a home-charging station.

Barriers Addressed: High Cost of Fast Charging

Challenges: Communicating the total cost of ownership for EV vs ICEV to commercial drivers and mitigating potentially long-dwell times by drivers.

Examples: Lyft partnership with Evgo on the Express Drive program.

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

Rebates for EV Drivers

Description: To offset the incremental cost of purchasing or leasing an EV, a program could provide a rebate for EV drivers. In the case of the TNC weekly rental programs, the value of the rebate should be incorporated into the weekly rate so that EVs are the lowest cost option. A rebate could also be performance-based, applied per electric vehicle-mile-traveled.

Barriers Addressed: High Capital Cost of EVs

Challenges: The incremental cost of purchasing or leasing an EV instead of an ICEV will decrease over time as the price of lithium-ion batteries continues to decline. Experts predict that compact EVs will achieve price parity with ICEVs between 2023 and 2026 depending on the vehicle size and range[85]. Any rebate should be periodically reassessed and adjusted to reflect these changes.

Examples: Uber 'EV Champions Initiative' (2018)

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

EV Cash-for-Clunkers Program

Description: An EV Cash for Clunkers Program would offer drivers an opportunity to trade in their used ICEV in exchange for a voucher that must be used to purchase or rent an EV for commercial use.

Barriers Addressed: High Capital Cost of EVs

Challenges: The environmental impacts of an EV Cash for Clunkers program are difficult to quantify and there is potential to distort the used car market. For TNCs and Peer Car share services, the companies do not procure the vehicles, and therefore, have limited influence on vehicle choice outside of the rental program.

Examples: The Clear the Air Foundation has an existing program and has taken 4,300 vehicles off the road (average age 19.3 years).

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

EV Education and Awareness Campaign

Description: An EV awareness campaign should be designed to educate commercial drivers on the economic benefits of EVs by providing a simple total cost of ownership comparison between EVs, conventional gas, and hybrid vehicles. The campaign would also include basic information about available EV models and features, charging costs and locations, available incentives, and the emissions benefits of electric transportation. EV drivers would be prepared and encouraged to promote these benefits to customers who express interest in learning more about EVs.

Barriers Addressed: Lack of EV Education and Awareness

Challenges: The dispersed and informal nature of these businesses may make it difficult to identify and target drivers for education. Those drivers encouraged to promote EV awareness with passengers would be hard to monitor or assess, and might inadvertently misrepresent the facts.

Examples: Uber's "EV Ambassador" campaign in Portland

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

EV Bulk Procurement for Commercial Fleets

Description: New mobility providers should leverage their buying power and offer drivers access to a greater selection of EV models than those currently available at Colorado dealerships, in partnership with dealers and auto manufacturers.

Barriers Addressed: Limited EV Model Availability and Vehicle Range

Challenges: Companies may be hesitant to make a large fleet commitment without more extensive data and experience with operating ZEVs.

Examples: EV Group Buy programs, Climate Mayors EV Purchasing Collaborative

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	No	Yes	Yes	Yes	Yes

Investments in Electric Micromobility Infrastructure and Education

Description: Electric micromobility options like shared electric bikes and scooters offer significant emissions and congestion benefits compared to both gas-powered and electric vehicle trips. As a result, funds might be used to better incorporate these new mobility options into the transportation system by building micromobility infrastructure like travel ways and parking spaces, and by creating a public education and outreach campaign to improve safety and system efficiency.

Barriers Addressed: Lack of EV Education and Awareness

Challenges: The micromobility space is quickly evolving and best practices are still emerging in cities across the country. In addition, shared and dockless micromobility devices are only allowed in a handful of cities across Colorado.

EV Perks: Prioritizing Queuing at Airport and High-Volume Locations

Description: Cities might consider managing curbside access and rideshare lines at high-traffic venues such as Denver International Airport to provide a competitive advantage for EV drivers. TNCs and taxi companies might also create such prioritization in their apps.

Barriers Addressed: High Cost of Fast Charging, High Capital Cost of EVs

Challenges: This strategy requires coordination across a broad group of stakeholders.

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	No	No	Yes	No	No

Traveler Support Services for EVs

Description: CDOT should integrate EV-specific equipment, materials, and training to its existing Courtesy Patrol and Traffic Incident Management (TIM) programs to ensure the safety and confidence of drivers, passengers, CDOT personnel, and first responders when dealing with roadside assistance and incidents involving EVs.

Barriers Addressed: Lack of EV Education and Awareness, Limited EV Model Availability and Vehicle Range

Challenges: There are technical and cultural challenges to providing a similar level of roadside service to EVs and ICEs at present.

Examples: AAA Colorado now offers emergency roadside EV charging.

Does this strategy apply to all six Transportation Providers?

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

6.2 Natural Environment Impact and Emissions Analysis Subcommittee

A. Colorado should foster the development of a clean and sustainable transportation system that is energy-efficient, space-efficient, and compatible with a stable climate.

- System-wide transportation policy should be aligned with and facilitate achieving the carbon pollution reduction targets set in HB 19-1261.
- The state should encourage the growth of new mobility business models that can contribute to a more stable climate, cleaner air, and healthier people. The state should actively unlock opportunities for those businesses to evolve in ways that reduce pollution and save money.
- The state should promote accelerated deployment of zero emission electric vehicles in new mobility services.
- The state should promote vehicle pooling and sharing in order to increase energy efficiency, reduce demand for transportation infrastructure, reduce the number of vehicles on the road,

and reduce pollution. Pooling efforts should encourage increased vehicle occupancy or package loading, rather than encouraging single-occupant or no-occupant vehicle trips.

  - Some policies should be directed at new mobility services. To maximize the effect, complementary policies should also promote sharing and pooling across the broader transportation system, including privately owned vehicles.

- The state should design policies with an eye towards the future. For example, policies should be flexible enough to help guide the possible introduction of autonomous vehicles in a socially and environmentally beneficial direction, if and when the technology matures.

B. Colorado should design and implement a fee applied to new mobility services.

- The fee should be structured in a way to promote reduced emissions and increased efficiency.
  - Companies should pay more for using polluting vehicles than zero-emission vehicles.
  - Fees should be higher for single-occupant or no-occupant trips, or for inefficient deliveries.
- A fee structure that most directly creates an incentive for shared, electric vehicles would be based on the amount of tailpipe carbon dioxide emissions per passenger-mile of travel (or per unit-mile for home delivery). This should include all miles traveled, including deadheading.
  - *Challenges to consider for this type of fee:*
    - *Drivers using multiple apps at the same time could lead to double-counting*
    - *App services could require users/drivers to report occupancy, but how to ensure that information is accurate?*
    - *Access to low-emission vehicles for freight delivery*
    - *May not be appropriate for rental car or peer-to-peer car-sharing services.*
- Alternate fee structures, (whether based on VMT, percentage of cost, or flat fee) should have modifiers applied that reduce costs for shared, electric trips and increase costs for inefficient trips taken in polluting vehicles.
- The fee should be set at levels sufficient to generate a meaningful amount of revenue, without unintentionally driving up emissions by discouraging beneficial new mobility business models. (To avoid this, the state should apply similar policy to privately owned vehicles at the same time. Options could include a registration "feebate," with charges or subsidies based on how clean or polluting a vehicle is, or a fee that captures the cost of carbon pollution on society from private vehicles).

C. Colorado should strategically invest the resulting fee revenue to programs that will steer the whole transportation system toward zero-emission vehicles and towards increased levels of vehicle pooling and sharing.

- How the state spends fee revenues is likely to be more impactful than incentives built into the fee structure.

- Colorado should strategically invest new mobility service fee revenue on programs that can unlock energy efficiency opportunities in the transportation sector through improved new mobility services. Priority should be placed on programs that:
  - Reduce tailpipe carbon emissions, such as by facilitating increased deployment of ZEVs in new mobility fleets;
  - Reduce pollution by reducing vehicle travel demand, including by:
    - promoting increased vehicle pooling,
    - prioritizing the movement of shared vehicles, for example in managed or dedicated lanes; or by
    - facilitating compact infill development rather than accelerating sprawl, thereby enabling shorter vehicle trips.
- The state should be open to spending fee revenue in ways that help new mobility companies replace less-efficient private vehicle trips and reduce system-wide pollution.
- Revenues from this fee should not be used for generic transportation infrastructure construction or maintenance, which do not necessarily reduce pollution or improve efficiency. (A broader fee applying to a much broader segment of the transportation system, such as a reformed gas tax, would be more appropriate for that).

6.3 Congestion Management and Shared Ridership Subcommittee

A. Develop a user fee structure for TNCs which has a graduated fee to be higher for non-shared rides and to be a reduced fee for shared rides.

B. Provide for a reduced fee structure for rides originating from or ending at mobility hubs in Colorado.

C. Expand existing voluntary employer transportation demand management programs through partnerships with Transportation Management Associations and Transportation Management Organizations.

D. Explore mandatory employer based Transportation Demand Management programs for employers over 100 staff.

E. Examine other incentives to promote car share, vanpools, carpools, mass transit, and other forms of shared ridership on a statewide basis.

F. Continue implementing targeted Transportation Demand Management strategies for construction zones and for special events.

G. Provide opportunities for shared ridership by developing statewide carpool matching website and smart phone App.

6.4 Social Impact and Equity Analysis Subcommittee

A. Recommendation #1: Any recommended fee structure should consider the ability of emerging technology companies to expand and grow in Colorado. The fees implemented should not hamper the development of innovative solutions especially for rural areas.

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

B. Recommendation #2: The fees should be reduced or eliminated where and when mobility options are limited, such as when public transit is less available during different times of the day and different days of the week.

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	No	Yes	Yes	No	No

C. Recommendation #3: As a fee structure looks to curb vehicle miles traveled of emerging mobility commercial providers, the Stakeholder Working Group should also consider the equity of the fee structure on companies, and on vulnerable and/or underserved populations. These populations include the vehicle operators (the drivers), passengers (the riders) and e-commerce package recipients.

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

D. Recommendation #4: The fees should be eliminated or minimized in transportation trips originating in low-income communities according to HUD definitions. Please see: https://drive.google.com/open?id=1dVJgX4o9zZZo9pFuLAi4H-pZAhD9v8Al

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	No	Yes	Yes	No	No

Rational: The Subcommittee chose to use the HUD definition of low-income communities due to its easier administration and simplicity than other sources.

E. Recommendation #5: The fee structure should be eliminated or minimized for the commercial delivery of groceries/essential goods in areas that are underserved by grocery stores or deemed "food desert" neighborhoods.

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
No	No	No	No	No	Yes

F. Recommendation #6: The fee structure should incentivize more affordable and accessible mobility options (e.g., car sharing, Uber/Lyft pools, mass transit) that help to discourage zero and single-occupant trips (e.g. personal vehicle ownership, or a single passenger in Uber/Lyfts)

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	No

G. Recommendation #7: The fee structure should incentivize 1st/Last Mile rides (The "last-mile" or "first and last-mile" connection describes the beginning or end of an individual trip made primarily by public transportation.)

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	No	No

Rational: The Subcommittee considers this a viable proposal to administer by designating certain areas reduced fee areas, like mobility hubs. Journeys that begin or end at a mobility hub would see the reduced fee.

H. Recommendation #8: The proposed fee would be applied to all Colorado municipalities.

TNC	Peer-to-Peer Car Share	Non-Peer Car Share	Taxi	Car Rental	Residential Delivery
Yes	Yes	Yes	Yes	Yes	Yes

Rational: The Subcommittee recommended that all of Colorado's municipalities participate in any fee program in order to reduce administrative burden. If a checkerboard of opt-in and opt-out areas developed it would be unclear how a fee should be charged in proportion to where the journey originated or terminated. As well, requiring statewide participation would reduce confusion and app development difficulties. Allowing certain communities to opt-out may even encourage TNC drivers to drive further in order to operate in a no-fee area, and thus causing more VMT, instead of reducing it.

Recommendations for Fee Revenue Use

Fee usage recommendations were not mutually exclusive, nor necessarily designed to all be enacted together. However, the subcommittee suggested a variety of recommendations that were designed to reduce existing inequities.

A. A portion of fees could be used as a "rebate" to low income passengers in order to reduce the financial impact of fees on said passengers

B. Fees could be used to build infrastructure in transportation deserts

C. Fees should be invested into communities of color, low-income, or transit deserts. Consideration should be given for how fees can be used to benefit said communities.

D. Fees should not be spent in a way that aggravates social inequity and transportation inequity between geographic areas.

6.5 Safety Subcommittee

Some recommendations may need to be started right away to get going (due to a long lead time), but may not be ready for implementation until the mid- or long-term stage.

Each of the policies starts as things that could be started on immediately. An annual or semi-annual review of each should be conducted. Data-oriented analyses take years of analysis to draw meaningful conclusions, so that is both an immediate concern but also a long-term outlook.

Table 6-1. Safety Subcommittee Recommendations

Recommendation	Near-Term Implementation	Mid-Term Implementation	Long-Term implementation
(Policy) **A.** Evaluate areas to improve hotspot pickup/drop-off locations to promote safety for all road users (e.g., pedestrians, vehicles, freight)	X	X	
(Data) **B.** Gather additional data to improve vehicle miles traveled (VMT) analysis necessary to understand trip generation (e.g., purpose, time of day, replacement vs. new trip)		XX	
(Data) **C.** Modify the crash form to collect additional data for vehicles driven for commercial purposes (TNCS, car share, package delivery, and others)		XX	

Table 6-1. Safety Subcommittee Recommendations

Recommendation	Near-Term Implementation	Mid-Term Implementation	Long-Term implementation
(Policy) **D.** Continue to promote research/innovation and provide infrastructure test beds as necessary/helpful, including advanced driver Assistance systems and connected and autonomous vehicle applications	X	X	XX
(Education) **E.** Educate Colorado drivers on emerging technologies (e.g., advanced driver assistance systems, TNCs)	X	X	X
(Policy and regulation) **F.** Review regulations on hours of service among various commercial providers (e.g., TNCS, taxis, car share, package delivery, and others)	XX		
(Education) **G.** Develop first responder training programs to educate on emerging technology impacts to crash scene management (e.g., EV batteries in a car fire)	X	X	
(Data) **H.** Gather additional data to better understand the safety impacts of the medical provision	XX		

6.6 Fee Structure for Emerging Mobility Providers Subcommittee

Fee Subcommittee members could not reach consensus or agreement on a single fee structure to recommend to the Working Group. As a result, the Fee Subcommittee recommends the Working Group consider one, or a combination of, the three fee structures modeled: mileage-based, flat, and percent-based. A summary of the key pros and cons of each fee structure identified by the Subcommittee is outlined in the table below.

Any fee structure should take into account the fees already imposed on the commercial vehicles covered by SB 19-239.

Table 6-2. Pros and Cons of Fee Structures Modeled

Fee Type	Pros	Cons
Mileage-Based Fee	Best fee structure to meet the goals of SB 19-239 Addresses emissions considerations Could capture deadheading	Challenging to administer Highly reliant on the use of technology to track mileage Requires increased data collection Concerns raised around privacy and the type of data collected
Flat Fee	Easiest to administer Requires less data One of the most common fees imposed by other states	Doesn't address the goals of SB 19-239 directly. However, funds generated could be used for this purpose. Low flat fee modeled was flagged as higher than other cities, outside of New York.
Percent-Based Fee	More representative of the length of a trip One of the most common fees imposed by other cities and states	Extremely difficult to administer for residential delivery Doesn't address the goals of SB 19-239 as directly as a mileage-based fee. However, funds generated could be used for this purpose.

CHAPTER 7. RECOMMENDATIONS AND NEXT STEPS

This chapter summarizes the recommendations of the Working Group based on the information and data generated and included in this report. It also includes the next steps CDOT is taking to respond to SB 19-239.

7.1 Recommendations from the Working Group

Over the course of four Working Group meetings, and several subcommittee meetings over six months, the Working Group provided critical feedback on several elements of SB 19-239. In the final discussion, stakeholders were asked to prioritize the recommendations from the subcommittees (included in full in Chapter 6 and in Appendix I), and provided general guidance and feedback on next steps. This included anonymous electronic surveys and robust discussion.

7.1.1. Policy Recommendations

Given the diverse interests among the stakeholders, no consensus was reached regarding a specific fee or structure; however, several recommendations were made to inform future policymaking.

- **Benefits of Emerging Mobility:** The state should recognize the financial, social, access, and societal benefits of emerging mobility technologies. TNCs, taxis, car rentals, and car sharing can increase access to transportation.
- **Social Equity:** A fee structure needs to take social and equity issues into consideration. Lower income people often are further away from their places of education and employment due to higher housing costs in urban areas, and may be disproportionately affected by a fee.
- **Demographic Change:** A fee structure needs to take into account the anticipated demographic changes in which fewer young people are driving and purchasing vehicles. Similarly, the growth of baby-boomers reaching over the age of 65 years means that more senior citizens will be seeking alternative mobility strategies as their physical capabilities decline with age.
- **Economic Development:** In order to not impact the ability of emerging technology companies to grow and prosper in Colorado, the state should recognize the financial burden of any potential fee on the emerging mobility companies cost of doing business.
- **Existing Fees:** Fee structures should consider all of the types of fees that emerging mobility providers are already contributing to offset their impacts to transportation infrastructure. As has been discussed in earlier chapters, many of these providers pay varying levels of fees to the State and localities in Colorado.
- **Support Transit:** Emerging mobility technologies should be used to connect to the existing public transit systems and enhance mobility access. A fee structure should incentivize first and last mile rides connecting to public transit, and possibly consider how micromobility services (bikes and scooters) factor into this framework.
- **Fee Indexing:** A fee structure should be indexed to inflation. Working Group members expressed a strong desire for the fee structure to have the capability to be amended to grow and change over the future.

- **Existing ZEV Efforts:** A fee structure should take into consideration that fact that commercial companies such as Amazon and Lyft have already made some level of financial investment to add ZEVs to their fleets. The fee structure should not inhibit these efforts, but rather should incentivize and support larger deployments of ZEVs and multimodal options (such as microtransit).
- **Congestion Pricing:** A fee structure should reflect congestion conditions, such as on a specific roadway corridor or within a specific geographic boundary, time of day, weather, delays, or special events.
- **Ease of Implementation:** Generally, the Working Group concurred that a flat fee would be easier for companies to implement because flat fees are already administered by other cities, airports, and states. A flat fee would require less data.
- **Alignment with SB 19-239 Goals:** In contrast, the Working Group generally concurred that a mileage-based fee would more readily meet the requirements of SB 19-239. However, this fee would be more difficult to implement and would require new development by the companies. Additionally, privacy concerns were discussed; CDOT assured stakeholders that this would be a first priority in developing any fee collection system, regardless of the fee structure selected by the legislature.
- **Graduated Fees:** The Working Group agreed that shared and ZEV rides should be discounted; while it was generally agreed that a shared and ZEV ride should have the lowest or no fee because it achieves both emissions and congestion reduction. There was disagreement about the level of discount for a shared ICE vehicle or a single-passenger ZEV, which only addresses one. The Working Group also suggested that possible financial incentives or "feebates" be offered for trips in shared rides. Overall, the fee should not offset the cost-savings a person receives when taking a pooled ride in a TNC or taxi.
- **Shared Ridership:** The fee structure should incentivize more affordable and accessible mobility options that help to discourage zero and single-occupant trips on a statewide basis.
- **Use of Fees:** While this was not a focus of the Working Group, based on the legislation, potential use of fee revenues was a frequent topic of conversation. The Working Group did not come to consensus. Most discussion focused on investments in zero emission vehicle infrastructure and programs, and in supporting public transit and transportation demand management; a few stakeholders focused on using revenues for road investment.
- **Flexibility:** The Working Group expressed interest in flexibility in the fee structure to change over time, both to reflect changing business models and technologies such as autonomous vehicles, and the idea that it may make sense to implement easier approaches such flat fees or percentage fees in the early days, while preserving an ability to transition to mileage-based fees as it becomes more technically feasible. This could include the creation of an Advisory Committee to continue discussion of these new technologies and their impacts on the transportation system, and an ability to modify fees through a CDOT administrative process.

7.1.2. Phased Implementation

Several of the recommendations above are complex and could take many years to develop. As discussed in the Working Group, these technologies are quickly evolving, and some experimentation and phasing will be required in order to implement a fee that meets the full intent of SB 19-239, should the State Legislature choose to proceed.

A fee structure could be implemented in phases in order to develop, grow, and mature capabilities to collect data and revenue from emerging mobility providers. Some of these companies already have complex logistical and dispatching computer software that can track number of trips, trip mileage, trip location of origin and destination, trip time of day and trip day of week. This software can maximize routing efficiency and track pooled or shared rides.

Some Working Group members expressed interest in implementing a mileage-based fee on emerging mobility providers that have advanced software capabilities.

Short Term

More data from emerging mobility providers and their contracted drivers would be helpful to inform the modeling in Chapter 5, real impacts of these services, and help the State begin building the appropriate data collection systems. CDOT can conduct consumer survey at some point in the future. There are several items identified for additional research specific to modeling in Section 7.1.3.

Based on feedback from the Working Group, implementation of a flat fee or a percent of transaction fee would be easier to put in place quickly. This could allow for initial revenue collection to offset administrative costs and begin investment in areas such as ZEV infrastructure.

Medium Term

Several of the recommendations discussed above include complex data collection and auditing that will take time to develop. These could be put in place over time, as the State develops the software and evaluates the real world impacts of these fees upon emissions and congestion. These changes would allow for a more comprehensive fee structure that takes into account the key priorities from the Working Group and SB 19-239, including congestion, emissions, safety, and social equity.

Long Term

Transportation technologies are rapidly evolving, and there should be long-term evaluation of any policy, fee, or other recommendations for emerging transportation technologies, as well as a method or dedicated group to keep a pulse on the movement of new transportation business models.

Additional consideration and discussion of phasing a fee structure is recommended.

7.1.3. Items for Additional Research

Because the mobility providers evaluated during this study are emerging and evolving, data and research documenting the impacts on the transportation system is relatively scarce. The impacts of the emerging mobility providers, as analyzed in this study, were based on the available data accessible within the timeframe of the study. This data and the assumptions made to develop the forecasts are well documented and are publicly available. As decision-makers grapple with these impacts, it was recognized the importance of continuously updating the knowledge base and conducting additional research and study to better understand the effects of policy, fees, and incentives on these industries and our natural and built environment.

In addition, several members of the Working Group highlighted the accelerated schedule to complete the research, modeling and report preparation, and would have appreciated more time to delve into the issues. An additional consideration is that the proprietary nature of this data will require CDOT to establish the appropriate systems to collect and secure this information going forward.

This section summarizes recommendations for further data collection, research, and study that were identified during the study process and by the subcommittees. Data collection methods are to be determined.

Specific recommendations related to data that would inform future modeling of impacts include:

- **Social equity analyses** for limited mobility or vulnerable populations.
- **Economic impact of additional jobs** across different population segments.
- **Professional or Casual Drivers:** Quantify who is driving a TNC for their job or just for extra cash on their usual travel with minimal deadheading to pick up passengers.
- **EV Adoption Incentives:** Better understand what incentivizes drivers to switch to an EV.
- **Shared Ride Incentives:** Better understand what incentivizes riders to take a shared ride, as well as the number of trips that are currently shared.
- **Medical Certification Research:** Collect data on the pattern of TNC crashes in Colorado, to analyze if the medical certification TNC driver requirement is warranted. Compare the TNC crash rates of other states with and without health certificate requirements.
- **Congestion Impacts:** Collect more data on trips by location and time of day. Trips made in more congested areas would increase delay and emissions, by just adding more vehicles and/or curb management issues. Assess which trips may be discretionary and which may be mandatory, which could provide additional sensitivity in the analysis of fee impacts.
- **Implementation of First and Last Mile Discounts and Interactions with Micromobility** (i.e., personal shared transportation devices like bicycles, mopeds, and e-scooters that are paid for through an app)**.**
- **Fleet Mix:** Update forecasts of ZEVs in the vehicle fleet to better inform emissions modeling
- **Autonomous Vehicles:** Project the percentage of TNC trips that will be in autonomous vehicles. Estimate the percent of future VMT that will be zero occupant vehicles.
- **Home Deliveries:** Collect data on the trip patterns of the wide variety of commercial deliveries to residences.
- **Offset Effect of Emerging Mobility Technologies on VMT:** For example, residential deliveries may offset VMT as compared to personal trips to the store.
- **Trip Length and Fare Elasticity:** Trips by trip length and fare – allows disaggregate evaluation of fee impacts, varying elasticity assumption to determine how pricing and length affects decision-making by provider type. In addition, better data could be collected regarding consumer choice elasticities.
- **Trip Logs:** number of trips, trip length, and geographic detail – allows modelers to validate a model that could assess mode shifts in between different modes, given similar characteristics, or shifts between modes given changes in fares / costs.
- **Analyses of Suppressed VMT:** Car-sharing providers have given data to researchers that have shown some customers forgo buying a car or selling a car because of the availability of additional mobility options. This may also be the case with other emerging mobility providers, especially as demographic and land use shifts occur over the next several decades.

- **Fee Scenario Elasticity:** Collection and analysis of passive data (specifically location-based services data, or cell phone data) would allow researchers to analyze a number of travel behaviors in Colorado.
- **Administrative Costs:** CDOT needs to further understand the administrative costs of implementing a possible fee structure, as well as collecting and securing data.
- **Tools to Reflect Emissions:** Other jurisdictions, California, in particular, are studying ways to most accurately capture the emissions impacts of vehicles. Observation and lessons learned from these processes will be advantageous to Colorado.
- **Zero-Occupancy Trips and Deadheading:** CDOT needs to further understand the possible impacts of deadheading trips (driving to pick up a new passenger), as well as future zero-occupancy trips with autonomous vehicles.

Potential data to be collected to inform future research is listed by provider type in Table 7-1.

Table 7-1. Future Research by Provider Type

Provider Type	Number of Vehicle Trips and Details	Other Data
TNC	Fare * Time of day, day of week * Trip length * Pooled vs non-pooled * Number of persons in the reservation (either pooled or non-pooled) Vehicle make/model Pick-up/drop-off location * Travel en route to pick up passenger * Travel while waiting for a reservation *	Geographic service area Number of drivers in Colorado Customer survey data with demographic/socioeconomic data information like household income, number of vehicles in the household, number of licensed drivers in the household, etc.
Car Share	Cost per reservation paid by user * Time of day, day of week of reservation start and end * Travel during reservation * - odometer reading is required in order to assess if the user drove more than the max, so they have this information Vehicle make/model * Pick-up location * State of residence for registered driver	Geographic service area * Number of drivers or vehicles in Colorado by geographic area Driver and customer survey data with demographic / socioeconomic data information like household income, number of vehicles in the household, number of licensed drivers in the household, etc. *
Car Rental	Cost per reservation paid by user * Time of day, day of week of reservation start and end * Travel during reservation * - odometer reading is required in order to assess if the user drove more than the max, so they have this information Vehicle make/model * Pick-up location *	Geographic service area *

Table 7-1. Future Research by Provider Type

Provider Type	Number of Vehicle Trips and Details	Other Data
	If the reservation is an insurance replacement vehicle State of residence for registered driver	
Taxi	Fare * Time of day, day of week * Trip length * Number of persons in the vehicle Vehicle make/model * Pick-up/drop-off location *	Number of vehicle trips with vehicle trips with the following details: Geographic service area Number of drivers / vehicles in Colorado
Residential Delivery	Third-party restaurant delivery Average number of daily orders/deliveries per restaurant Average trip length of delivery (include deadhead separately) Average delivery cost per order On-line grocery delivery Percentage split between customer pickup and delivery of online orders Average delivery fee per order (please account for membership fees) Average number of online grocery orders per day Average trip length of delivery (include deadhead separately) Parcel delivery Average number of residential deliveries per day Average trip length per delivery (include deadhead separately) Average shipping cost (paid by consumer) per delivery	On-line grocery delivery Annual online orders and deliveries (2016-2019) Parcel delivery Annual miles in Colorado (2016-2019) Average number of deliveries in Colorado (2016-2019) Number of routes in Colorado (stratified by location (e.g. urban, rural, county) Average trip length per route Average number of daily residential deliveries per route

** Denotes data that has previously been available publicly (i.e., there's a precedent, process, etc., for providing this), has been provided to researchers before in released studies (not necessarily publicly available), or data already collected for various reasons.*

The subcommittees identified needs for further study, as indicated in Table 1-2. Further information can be found in the reports from the subcommittees included in Table 7-2.

Table 7-2. Future Research Suggestions from Subcommittees

Subcommittee	Research Recommendations
Incentivizing Zero-Emission Vehicles Subcommittee	The Stakeholder Working Group and the Legislature should consider the place of (non-plug-in) hybrid electric vehicles (HEVs) and other low-emission vehicles in any potential fee structure.

Table 7-2. Future Research Suggestions from Subcommittees

Subcommittee	Research Recommendations
	Another consideration is whether Residential Delivery companies merit additional consideration in a potential fee structure, given the current lack of medium-duty ZEV models available on the market. Arguably a fee structure that incentivizes ZEVs would not produce meaningful results for this type of business if there are no viable vehicles for them to adopt. It may be prudent to revisit this question in future years as the market for medium-duty ZEVs expands and makes such a transition more feasible.
Natural Environment Impact and Emissions Analysis Subcommittee	Evaluate how rapidly home delivery is expanding in Colorado and its effects on VMT and pollution. No specific estimates of net GHG impact of new mobility services in Colorado currently (but maybe model results can help us get at that in the 2030 baseline forecast).
Congestion Management and Shared Ridership Subcommittee	In order to evaluate how effective any strategy is at increasing shared ride trips, the baseline for shared ride trips should be estimated.
Social Impact and Equity Subcommittee	As stated in the Transportation Provider Service Coverage in Disadvantaged Areas in Colorado (available in Appendix E), "It is recommended that the State of Colorado gather additional data sets on number of providers and location of service areas from the different emerging mobility providers. This data could be compared before and after a potential fee structure is implemented to assess the impacts on the vulnerable populations in Colorado." The Subcommittee discussed how Lyft and Uber decide their price points, and customer price sensitivity. It would be helpful to understand who would be impacted by a fee, so it could be structured to avoid impacts on low-income communities. Understanding this would help find a balanced fee that benefits shared rides, decreases environmental impacts, and allows people to use TNCs when transit isn't operating. Different disadvantaged populations within Colorado may have different needs, thus, one single policy may not appease all disadvantaged communities. Fees on transportation providers may unintentionally harm drivers, passengers, and disadvantaged populations. The impact of fee structures on drivers and their income was not resolved by the Subcommittee.
Safety Subcommittee	Gather additional data to improve vehicle miles traveled (VMT) analysis necessary to understand trip generation (e.g., purpose, time of day, replacement vs. new trip). Modify the crash form to collect additional data for vehicles driven for commercial purposes (TNCS, car shares, package delivery, and others). Gather additional data to better understand the safety impacts of the medical provision and other driver qualifications, certifications, training needs. Establish periodic emerging technology reevaluation, particularly from a safety standpoint.
Fee Structure for Emerging Mobility Providers	Road user charge (RUC) (otherwise known as a "mileage-based fee") study results. Number of vehicles on the road and total vehicle miles traveled (VMT) for revenue projections. Fee structures that have been effective at raising revenue and incentivizing desirable behavior in other states or countries. How revenues from fees in other states and/or cities have been spent.

7.2 Information and Recommendations from Freight Advisory Council

SB 19-239 directed CDOT to include a representative of the Colorado Freight Advisory Council (FAC) in the Working Group to provide information and recommendations regarding “current and evolving practices related to the residential delivery of goods.” This section summarizes the agency’s input and recommendations. The full memorandum submitted by the FAC is included in Appendix J**.**

The nature and history of the commercial freight industry is described to provide context. Commercial goods carriers are both larger operators like UPS, DHL, FedEx, Ryder, Amazon, and smaller independent parcel delivery, courier, and light trucking operators that distribute goods to final destinations. According to the FAC letter, this is a mature industry with well-established federal and state oversight, regulation, and tax and fee systems that is adopting new technologies to increase efficiencies and should not be considered similar to new emerging forms of mobility such as transportation network companies. The letter argues that only a small portion of the commercial vehicles engaged in the residential delivery industry fit within the definition of SB 19-239 because most cargo step vans used by the larger companies exceed 14,000 lbs.

Commercial vehicles engaged in the residential delivery industry are generally required to comply with a wide array of certification, driver and vehicle safety, insurance, licensing, and business operation fees and taxes. These include the Federal Motor Carrier Safety Administration, the U.S. Department of Transportation, and the State of Colorado. These fees and compliance costs are embedded in every parcel delivered in Colorado. In addition, private firms have adopted driver safety, licensing, operations, and vehicle maintenance standards that are more stringent than federal and state regulations.

The FAC recognizes the concerns related to the impacts of carbon emissions and vehicle miles traveled on the transportation system and environment and is already adopting new technologies, operational techniques, and sustainability initiatives to address these and to remain competitive. Some examples include reducing VMT, reducing fuel consumption and increasing delivery efficiencies, managing fleets for efficiency, adopting EVs, and utilizing common spaces for delivery, such as Amazon lockers.

At this time, the FAC believes there is a lack of data or information related to the scope of which companies are significantly engaged in residential delivery and the magnitude of those home deliveries, including volumes, trip lengths, emissions impact, and overall trends. Without additional data and better information, it is difficult to assess the actual impacts of supply chains and residential delivery options on carbon emissions and trip generation.

Considering the unintended consequences and long-term net impacts of potential fees, the FAC cited challenges related to implementation of a residential delivery fee. The fee could cause consumer behavior change that increases VMT because in many cases, residential delivery results in less emissions and VMT than consumers making trips to physical stores. The cost of compliance and administration of a fee could be passed on to consumers, but it is unclear how fee information would be disseminated and collection enforced. A fee based on a percentage of the transportation service cost would be difficult to determine and may lead to inaccurate assumptions or penalties for consumers in rural areas. Social equity concerns arise with a flat fee that would not distinguish type of deliveries. A lack of precedent of a similar fee leads to uncertainties on its potential impact, challenges, costs, or implications.

7.2.1. FAC Recommendations

A key recommendation to the SB 239 Working Group from the FAC is the consideration of new or additional information and education campaigns to inform consumers and the general public on methods and ways that they can be a "greener consumer" in regard to residential deliveries. Such a program would stress the environmental benefits of bundling on-line deliveries and look at designating a specific day of the week for deliveries and requesting that delivery during an off-peak time. This strategy could be effective in providing for more efficient transport of parcels and other goods which would reduce the number of package delivery trips, leading to substantially less VMT and lower emissions. Consumer information could help to change behavior and could be coordinated with other travel demand management initiatives already in place across the state.

Currently, there is no state or municipality in the country that applies a specific fee on residential deliveries so there is no reference point or impact evidence available to consider in establishing such a fee. Based on the lack of information and the limited research on these residential delivery operations or the possible assessment of fees on them there is no way to discern the impact, challenges, costs, or implications of assessing such a fee. For these reasons, the FAC would suggest to the Working Group that no specific fee on residential delivery services be recommended at this time.

7.3 Considerations Beyond the Scope of SB 19-239

While the Working Group focused its time on the tasks outlined in SB 19-239, several items were repeatedly raised by the stakeholders.

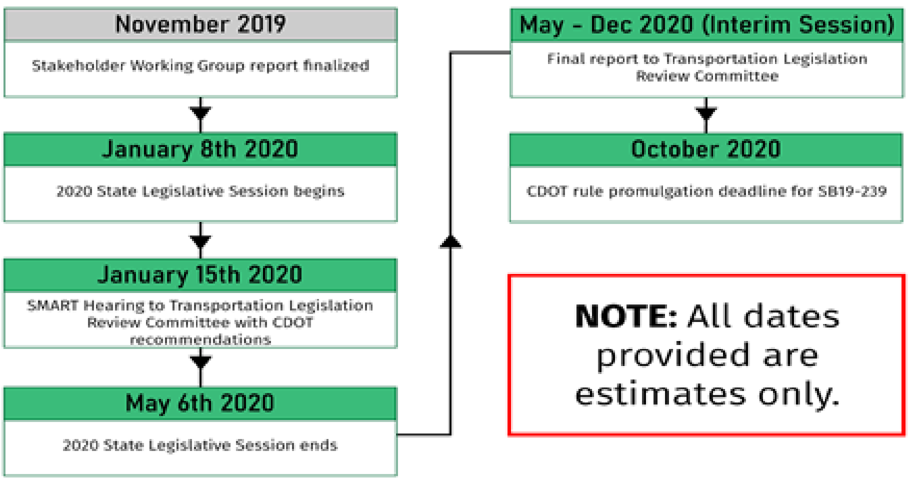
- **Safety:** The Safety Subcommittee and the Working Group acknowledged the rapidly evolving nature of transportation technologies, and under this study focused on the technologies that are present and touch the consumer base today. Technologies, such as autonomous vehicles, remain in much of a testing and development environment. Therefore, the State of Colorado should keep a pulse on the movement of those business models as their market penetration and touch to the consumer increase.
- **Alignment with HB 19-1261:** Members of the Working Group were interested in a more fulsome discussion of how a fee structure will help reduce the emissions from the transportation sector as a whole. Without representatives of the other, larger portions of the transportation industry, it was difficult to analyze or commit time to this particular discussion.
- **Application of Fee Revenue:** Members of the Working Group made several inquiries to how the potential fees on emerging mobility providers would be spent by the state. Several times during the subcommittee meetings and the Working Group meetings, members offered ideas for how to spend the revenue. These were aligned with the items outlined in the legislation (multimodal infrastructure and infrastructure needed to support the adoption and use of zero-emission vehicles), including EV charging infrastructure, rebates for drivers to purchase ZEVs, and subsidies to employers and transit agencies to operate programs that eliminate single-occupancy trips, such as vanpools. These ideas and others could inform potential categories of eligible spending for future legislation.

7.4 Next Steps for CDOT

From June to October 2019, CDOT convened four Working Group meetings to discuss and provide policy recommendations (1) regarding the impacts of emerging mobility technologies, (2) examining a potential fee structure to generate revenue to mitigate impacts, incentivize the adoption of ZEVs, and multiple passenger ride-sharing, and (3) examining a repeal of the Public Utilities Commission's requirement that a TNC driver obtains a medical certification. Following completion of this process, giving strong consideration to the Working Group feedback and the report, CDOT will present recommendations to the State Legislature in January 2020. Following the 2020 Legislative Session, CDOT must promulgate rules by October 1, 2020.

Participants in the Working Group committed a significant amount of time and energy to this effort, and it is deeply appreciated. The feedback provided herein will be vital in any future policy discussions, and the relationships created throughout this effort will be critical in implementing any potential legislation.

Figure 7-1. Summary of Next Steps for CDOT



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