Transportation Commission of Colorado
Technology Committee Agenda
Wednesday, October 19, 2016
4201 East Arkansas Avenue; Auditorium
Denver, Colorado

Shannon Gifford, Chairwoman
District 1

Ed Peterson
District 2

Kathy Gilliland
District 5

Kathy Hall
District 7

Rocky Scott
District 9

HERMAN STOCKINGER
Policy and Government Relations Director/Secretary

The Chairwoman may change the item sequence or timing

1. **Call to order**
2. **Autonomous Vehicle Policy**
3. **Road X**
4. **Public Private Initiatives Program Proposals**
5. **Adjourn**

COLORADO
Transportation Commission

4201 East Arkansas Avenue, Room270
Denver, CO 80222-3406

DATE: October 14, 2016
TO: Transportation Commission
FROM: Peter Kozinski, RoadX Program Director, Ryan Rice, TSM&O Director, Amy Ford, Director of Communications
SUBJECT: RoadX Policy and Funding

Purpose
To update and confirm with the Commission two policy directions related to the RoadX program.

1. Autonomous Vehicle Policy
2. Funding Policy

Action
In the fall of 2015, CDOT launched the RoadX Program, Colorado's bold commitment to team with public and industry partners to be a national leader in using innovative technologies to improve the safety, mobility and efficiency of the transportation system – fostering Colorado's continued economic vitality.

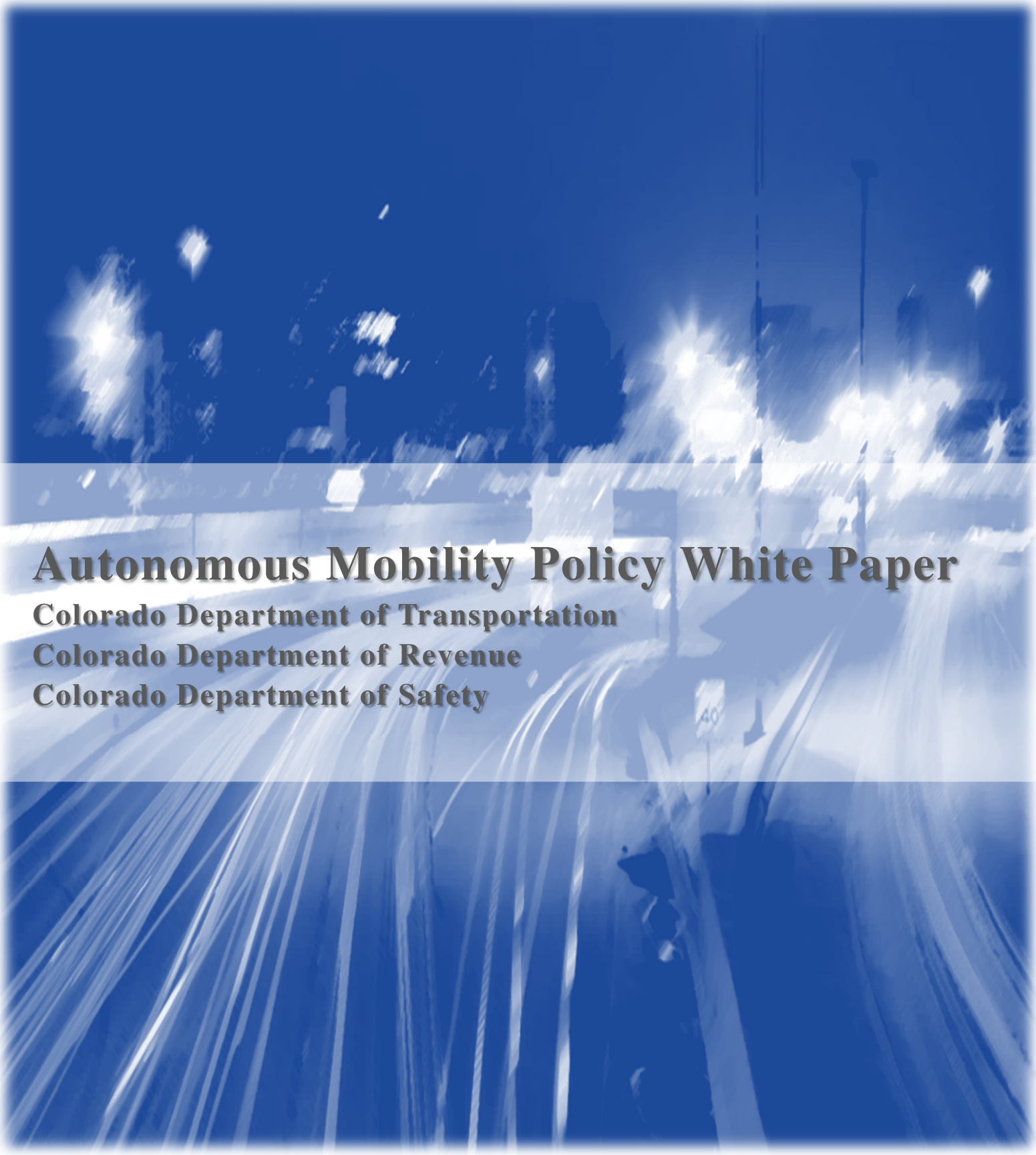
To achieve our mission, RoadX knew it would need to develop a business model not to dissimilar to that of a startup business. During our first year we focused on four (4) key areas – program awareness, partnerships, innovative approaches to current problems and program delivery.
Background

1. Autonomous Vehicle Policy: The Colorado Department of Transportation (CDOT), Colorado Department of Revenue/Division of Motor Vehicles (DMV) and the Department of Safety/Colorado State Patrol (CSP) have worked together to begin establishing a consistent policy direction in support of an autonomous mobility future.
2. Funding Policy: The RoadX team has established a funding direction and criteria by whichh to select and choose RoadX projects and how to incorporate RoadX project into the overall CDOT funding structure. Additional discussions have been started looking at the long term funding and possible organizational structure. Will also provide additional detail about RoadX budget

Details

1. Autonomous Vehicle Policy: The Colorado Department of Transportation (CDOT), Colorado Department of Revenue/Division of Motor Vehicles (DMV) and the Department of Safety/Colorado State Patrol (CSP) have worked together to begin establishing a consistent policy direction in support of an autonomous mobility future.
2. Funding Policy: The RoadX team has established a funding direction and criteria by whichh to select and choose RoadX projects and how to incorporate RoadX project into the overall CDOT funding structure. Additional discussions have been started looking at the long term funding and possible organizational structure.

Attachments
Autonomous Vehicle Policy White Paper
Funding Policy Powerpoint



Autonomous Mobility Policy White Paper

Colorado Department of Transportation
Colorado Department of Revenue
Colorado Department of Safety

DRAFT 08/2016

VISION

Transportation in the 21st century will be transformed as demographic shifts collide with information technology, vehicle technology and disruptive business models. The state of Colorado is committed to using innovative technology to save lives, improve mobility and foster the continued economic vitality of our state as the transportation paradigm transitions to autonomous mobility.

To do so, Colorado must have a nimble regulatory and policy structure that enables innovation while at the same time being protective of the travelers in the state of Colorado. The goal is to foster an environment where industry has the flexibility to deploy safe and innovative technological solutions to transform an aging transportation system. Equally, Colorado is focused on ensuring that the state's policies serve as the bridge between the traveler and the new technology, protecting their safety and providing clarity in understanding about roles and responsibilities.

PURPOSE

COLORADO'S GOAL IS AN AGILE POLICY FRAMEWORK THAT ENABLES TRANSPORTATION INNOVATION WHILE CREATING A HOLISTIC EXPERIENCE THAT HELPS THE TRAVELER, REGULATORY & ENFORCEMENT AGENCIES AND OTHERS SAFELY AND WITH CLARITY ADAPT TO THE CHANGING TRANSPORTATION ENVIRONMENT AND TECHNOLOGY.

SHAPING AUTONOMOUS MOBILITY POLICY

The Colorado Department of Transportation (CDOT), Colorado Department of Revenue/Division of Motor Vehicles (DMV) and the Department of Safety/Colorado State Patrol (CSP) have worked together to begin establishing a consistent policy direction in support of an autonomous mobility future. To begin, the agencies establish that the state is not directly responsible for validating safety of the vehicles and their evolving technology and Colorado's anticipate that the National Highway Transportation Safety Administration (NHTSA) will establish best practice guidance to industry on the principles of safe operation for autonomous vehicles. In the absence of any national framework and consistent with our current state laws, we are, however, responsible for establishing the basic policy structure for how the vehicles interact with each other and a policy environment that defines who is the "driver" and how autonomous vehicles would operate on Colorado roads.

DEFINITIONS

NHTSA has defined four levels of vehicle automation. Currently, some vehicles (Tesla, BMW, Mercedes) are on the road with Level 2 automation and Google, Uber and Volvo are testing Level 4 vehicles in the US and in other countries. Others automotive and technology firms are quickly following.

LEVEL 0	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
No Automation	**Function-Specific Automation**	**Combined-Function Automation**	**Limited Self Driving Automation**	**Full Self-Driving Automation**

The "traditional" version of car design that dominated through the 20th century. The driver is in complete and sole control of the primary vehicle controls – brake, steering throttle and motor power – at all times. Automatic gears are still counted as Level 0 automation.	Involves automation of one or more specific control functions, e.g. electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to stop faster than possible by acting alone.	Automation of at least two primary control functions working in unison to relieve the driver of control. An example of combined functions enabling a Level 2 system is adaptive cruise control in combination with lane centering.	The driver can cede control of all safety-critical functions under certain conditions, and rely on the vehicle to monitor for changes that require transition back to driver. The driver must be available for control, after some transition time.	The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. The driver will provide destination or navigation input, but is not expected to be available for control at any time. Source: Don Hunt, Traffic Technology International, April/May 2016

The state of Colorado maintains that all Level 0 – 3 vehicles must comply with applicable traffic and motor vehicle laws in the state and that Level 4 vehicles will require additional definition.

OTHER STATES

Currently, there are six states that have laws in place for autonomous vehicles: California, Florida, Louisiana, Michigan, Nevada, and Tennessee, as well as Washington, D.C. Of these, California, Florida, and Nevada share the same basic definitions for "autonomous vehicle," "autonomous technology" and "operator":

TERM	DEFINITION
Autonomous Vehicle	Any vehicle equipped with autonomous technology.
Autonomous Technology	Technology that has the capability to drive a vehicle without the active, physical control or monitoring by a human operator.
Operator	The person who causes the autonomous technology or autonomous vehicle to engage, regardless of whether the personal is physically in the vehicle while it is engaged.

The regulatory framework for autonomous vehicles in California and Michigan allow testing by manufacturer personnel, while in Florida and Nevada, testing is not restricted only to the manufacturer. For liability, California, Florida, and Nevada require manufacturers to have $5 million in insurance. These three states also impose the same requirements on autonomous vehicle capability during testing:

- Vehicle has mechanism to engage and disengage the autonomous technology that is easily accessible;
- Vehicle has visual indicator of when autonomous technology is engaged; and
- Vehicle has system to safely alert operator if there is a failure of autonomous technology, and either require the operator to take control, or if the operator is unable to take control, is capable of coming to a complete stop.

Many other states have introduced bills that closely mirror California, Florida, and Nevada's regulatory framework. Michigan is in the process of introducing bills that move beyond testing to enable the sale and operations of autonomous vehicles on the road. Additionally, NHTSA will soon release guidance on safe operation for fully autonomous vehicles.

AUTOMOTIVE/TECHNOLOGY INDUSTRY CONSIDERATIONS

Some automotive representatives have expressed the desire for the US to develop guidelines for the testing and certification for autonomous mobility. Others believe that there is need to eventually establish national guidance on Level 3 and 4 vehicles but because the technology is still in development, a more conducive strategy would be to work collaboratively together. The potential is, however, that in absence of a national framework, a patchwork system of state laws and regulations could stifle the market and potential benefits of automated vehicles. That said, automakers and technology firms are currently only testing Level 4 vehicles in states with enabling legislation (Level 2 vehicles are currently on the road across the US and operate under existing regulations). Interestingly, much of the industry believes that Level 3 vehicles have an unreasonable expectation to reengage a driver during an emergency, and due to those safety concerns, have moved towards Level 4 technology.

Those currently testing Level 4 vehicles have accepted all liability for any accidents or violations while the vehicles are in fully autonomous mode. There is also some development of after-market Level 2 – 4 automation, which drives additional discussion about who is responsible for liability, the technology entity or the installer.

Lastly, in addition to automotive testing of Level 4 vehicles, commercial vehicle firms have also been working on connected vehicle and self-driving technologies. Testing has operated under existing national and state regulations in states like Michigan, Utah and Nevada. It is anticipated there will be a variety of national regulatory shifts (driving hours, stopping at ports of entry, weigh stations, running truck platoons, etc.) pending the technology.

ENFORCEMENT CONSIDERATIONS

Because Level 2 vehicles are currently on the road, law enforcement is applying all existing regulations to any vehicle or driver involved in accidents or moving violations. This includes the assertion that the driver (regardless of whether lane centering/cruise control/automatic braking are activated) is responsible for the vehicle and must follow all traffic laws (exercising due care, reckless/careless driving, following too closely, accident reporting, etc.), licensing and insurance requirements. Enforcement believes that the same standards should apply to Level 3 vehicles as the driver is still responsible during an emergency.

For Level 4 vehicles, a number of questions still remain about how the computer or "automated driving system" will interact with various situations on the roadway. It is anticipated that the the automated driving system, more aptly defined as the "operator" rather than the "driver," will need to do more than simple drive and stop on the road. For example, it must be able to recognize enforcement officials in a roadway flagging them over at a traffic stop or DUI checkpoint. It is also anticipated that tickets will be issued to the automotive/technology entity responsible for the automated driving system. Electronic Data Recorders (EDR) in the vehicle will also become increasingly important for investigators as they address crashes or violations of traffic and motor vehicle laws.

There are additional elements that must also be considered related to the requirements of commercial motor vehicles. For example, a Level 4 autonomous commercial motor vehicle must

be able to still implement chain laws on a highway or understand when a Port of Entry is closed. It is anticipated that federal guidelines will also address these issues.

Lastly, other questions also arise about the transport of illegal products in both passenger and commercial vehicles. In some instances one could anticipate that laws such as those governing commercial vehicles or even the federal postal laws (which prohibit the shipping of illegal products) would apply to all Level 4 vehicles.

INSURANCE INDUSTRY CONSIDERATIONS

Currently the automotive/technology entities who are testing Level 4 vehicles have accepted full liability for any accidents or violations while the vehicles are in autonomous mode. As all states currently and will continue to require proof of insurance for all vehicles, this could significantly change the current model of the type of insurance and how insurance is secured. In the long term, insurance will likely shift risk coverage from "human error" to "technical failure" (source: McKinsey July 2016). Instead of individual policies for millions of drivers, the insurance model may shift to cover the small number of automotive/technology entities, similar to the current model for cruise lines or marine shipping companies. States, however, will still require that each vehicle on the road provide proof of insurance and it is anticipated that the named holder of the insurance will be some combined approach between the automotive/technology entity and person who owns the vehicle.

POLICY DIRECTION

Supportive laws and regulations that both encourage transportation innovation and provide safety and clarity about roles and responsibilities in an autonomous mobility future are critical. As such, CDOT, DMV and CSP establish the following steps as the path forward:

- **Confirm that all existing traffic and motor vehicle laws and regulations apply to Level 0 – 3 vehicles.** Colorado's priority is to not complicate existing laws. The state asserts that if a person, and not the automated driving system/computer, is asked at any point to be responsible for the vehicle, the individual behind the wheel holds all responsibility as the "driver." All existing laws will apply to that driver.
- **Enable autonomous mobility on Colorado roads.** Colorado's priority is to clarify any existing legislation and rules that will enable part or full-time Level 4 autonomous vehicles on the roadway. The state's goal is to provide simple definitions that define that anticipated future state, including:
    - **Motor Vehicle:** All Level 4 capable vehicles will still be defined as a motor vehicle.
    - **Driver/Operator:** The automotive/technology entity responsible for the full or part-time Level 4 automated driving system of the vehicle will be defined as

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the operator. *(Level 0 – 3 laws will continue to refer to the "driver" and will not require change.)*

- **Insurance:** The automotive/technology entity responsible for the full or part-time automated driving system will be responsible for the liability and for the insurance coverage of the vehicle while in Level 4 mode, proof of which will be necessary to operate on Colorado roads. Insurance coverage standards will follow current minimum requirements. (If Level 4 mode is not engaged, current laws about liability for the "driver" will apply).
- **Titling and Registration:** Titling information must document if the vehicle is a Level 4 capable vehicle. Vehicles must support an intelligent data driven connection to identify the vehicle as Level 4 for infrastructure and enforcement. In absence of a technology connection, Level 4 vehicles must have a visual indicator.
- **Enforcement:** In all instances where the automated driving system is responsible for the interactions on the road, the automotive/technology entity will be responsible for complying with and will be responsible for any violations of the Uniform Traffic Code. Equally, the automatic driving system must be capable of reporting accidents to the state/enforcement. This includes providing access to data collected by Electronic Data Recorders (EDR) to support any investigations. Any traveler in and/or owner of the vehicle is also still responsible for reporting any accidents, remaining on scene and rendering any information or aid as required by law.
- **Security and Illegal Activity:** It will be a crime to attempt or obtain unauthorized access the electronic data of a motor vehicle to obtain data or control of the vehicle. Also, transport of any illegal products in autonomous vehicles will be prohibited.

- **Outline whether Colorado needs to establish legislation to permit testing or whether legislation that permits Level 4 vehicles is sufficient for testing environments.** Colorado will continue to work with legislators, industry and others to determine if it is necessary to establish a formal testing environment prior to legislation that permits the sale and public operation of Level 4 vehicles.
- **Follow the NHTSA policy making and defined safety standards for the operation of fully autonomous vehicles.** Colorado establishes that the state is not directly responsible for validating safety of the vehicles and their evolving technology and as they do with current vehicles, NHTSA will be responsible for developing and implementing the regulations that govern the safety of the vehicles.
- **Monitor additional areas for potential new legislation and/or rule-making with the intent of balancing both innovation and safety.** Colorado will continue to monitor the national and international development of policy frameworks for autonomous driving; how to approach connected and automated vehicle data; work on compatible vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) systems; and monitor and coordinate on data and vehicle security. Additionally the state will be tracking issues of taxing structures as related to titling/registration (especially for fleets) and implications to revenue for state/local jurisdictions.

If Colorado succeeds in establishing clarity in the state's laws and regulations, this will enable the benefits of innovative technology to boost the health and safety of the transportation system, connect Colorado's economy and its residents' lives - giving people the freedom to decide how, when and where they want to travel.

COLORADO'S ROAD X

POLICY AND FUNDING APPROACH

SUPPORTING ROADX

TECHNOLOGY COMMITTEE

POLICY

FUNDING/RISK
STRATEGY FRAMEWORK

PEOPLE

WORKFORCE OF
THE FUTURE

PLANNING

PROJECT LEVEL DEEP DIVES
FIVE YEAR STRATEGY

RoadX **FUNDING CRITERIA**:

COMMUTING

TRANSFORM COLORADO INTO THE MOST RELIABLE TRANSPORTATION SYSTEM FOR COMMUTING IN THE NATION BY DEPLOYING TECHNOLOGY AND INFRASTRUCTURE SYSTEMS TO IMPROVE RELIABILITY OF TRAVEL TIMES AND OPTIMIZE ROUTING AND MOVEMENT OF COMMUTERS.

TRANSPORT

DEPLOY EMERGING IN-VEHICLE TECHNOLOGY AND SUPPORTING INFRASTRUCTURE TO IMPROVE THE SAFETY AND EFFICIENCY OF TRANSPORTING FREIGHT.

CONNECTION

DEVELOP SOLUTIONS TO TRANSFORM DATA INTO ACTIONABLE INTELLIGENCE AND DELIVER TO DRIVERS, CELLULAR/MOBILE APPLICATIONS AND CONNECTED AND AUTONOMOUS VEHICLES.

RoadX **FUNDING CRITERIA**:

SUSTAINABILITY

BECOME THE NATION'S LEADER IN ENERGY CONSERVATION AND EMISSIONS REDUCTION.

SAFETY

MAKE A DRAMATIC LEAP TOWARDS ZERO DEATHS ON COLORADO ROADWAYS.

FUNDING STRATEGEY

- RoadX funds pilots and early deployments

- Assess project feasibility based on five criteria

- Some efforts will include:
  - RFPs for researched RoadX technologies
  - Challenge programs to bring best concepts
  - Public Private Partnerships

FUNDING STRATEGEY

- Initial projects review based on:
  - Technology and transformative impact
  - Return on investment (or potential return on investment based on five criteria)
  - Potential for additional public private partnerships
- Expanded deployment included in existing CDOT funding:
  - Asset Management
  - Operations
  - Safety

FUNDING STRATEGEY

- Exploring broader organizational / funding strategy that enables:
  - “Fee for service” funding (use of wireless system, data, charging infrastructure)
  - Broader public private partnerships
  - Shared intellectual property ownership
- Reviewing enterprise or non-profit structures
  - UK Model
  - Hawaii Model
  - HPTE Model

RoadX **BUDGET**:

FOCUS AREA	PROJECTS	TOTAL*	FY16	FY17	FY18	FY19
Commute	Smart 25	$7.60	$0.90	$5.00	$1.70	
Connection	Smart 70 from Golden to Vail	$11.20	$1.00	$5.75	$3.25	$1.20
Transport	Smart Truck Parking	$0.40		$0.40		
Connection	Place Global	$0.02		$0.02		
Connection	Blynsy	$0.03		$0.03		
Program Support						
	Consultant Support	$1.05	$0.30	$0.75	$0.75	
	PR & Marketing	$0.20	$0.05	$0.15		
	Grant Writing	$0.05		$0.05		
	Total Committed	$20.55				

*Totals in millions

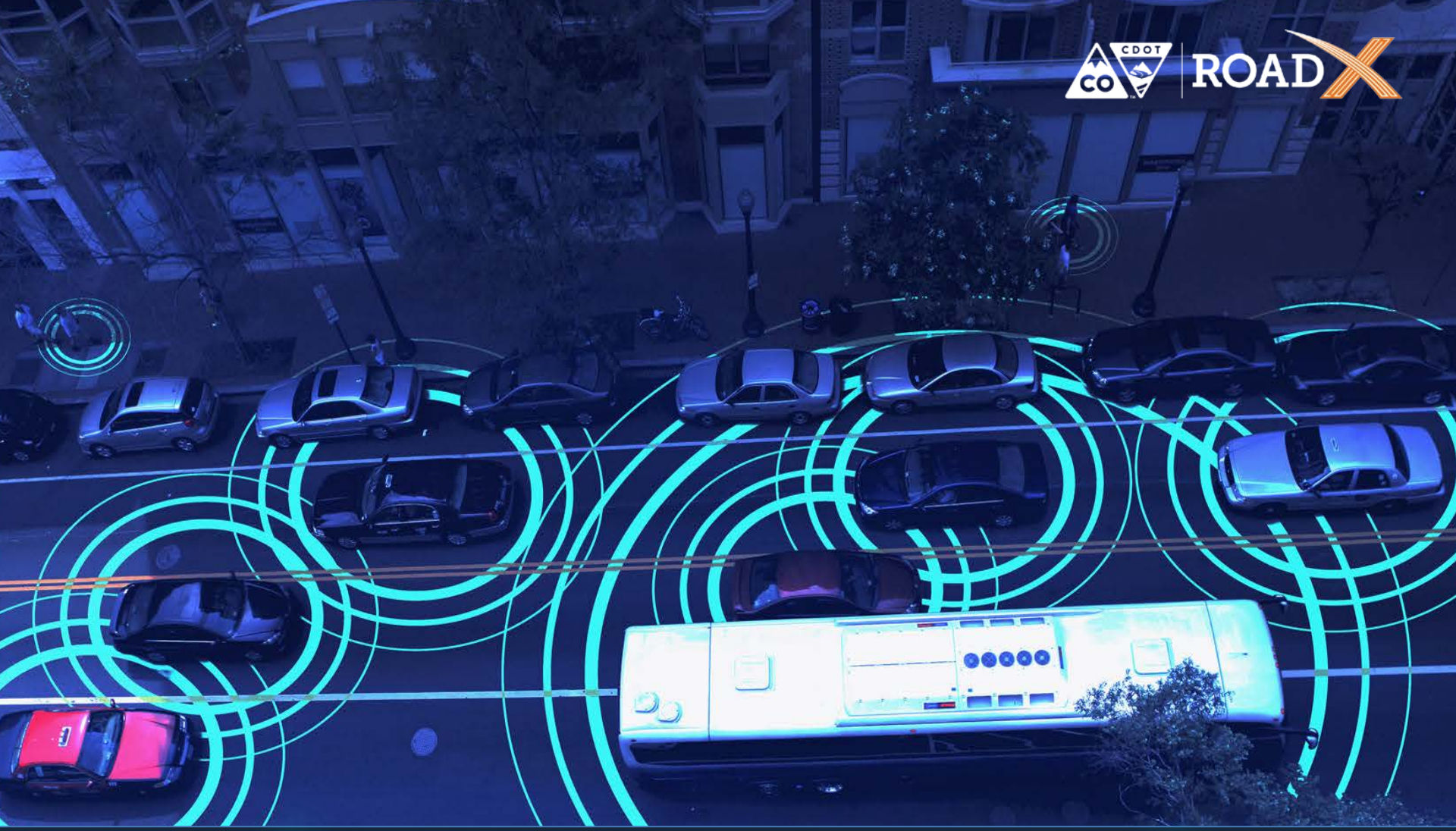
RoadX **PROPOSED PROJECTS/FUNDING**:

FOCUS AREA	PROJECTS	TOTAL*
Connection	Expand Smart 70 Cellular CV	$4.00
Connection	Smart Roads CV/AV Data Program Blueprint	$8.5
Connection	Fiber Broadband Office with OEDIT	$0.75
Sustainability	Ped / Bike Connectivity Challenge	$0.50
		$13.75
Safety	Smart Pavement US 285	$2.75
Transport	Smart City Denver I-70 Peleton	$2.00
Safety	Rural Safety Challenge	$2.00
Sustainability	Planning (Also working with DRCOG and Mobility Choice)	$1.00
	Total	$21.50

*Totals in millions

	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19
Roll Forward	$ -	$ 7,560,000	$ (5,693,475)	$ (8,371,950)
Initial Budget	$ -	$ 12,096,525	$ 12,096,525	$ 12,096,525
Supplement	$ 10,000,000	$ -	$ -	$ -
Total Budget:	**$ 10,000,000**	**$ 19,656,525**	**$ 6,403,050**	**$ 3,724,575**

Focus Area	Projects	Expenditures				Project Total
Administration	Administration	$ (190,000)	$ (200,000)	$ (350,000)	$ (350,000)	$ (1,090,000)
Commute	Smart 25	$ (900,000)	$ (5,000,000)	$ (1,700,000)		$ (7,600,000)
Connection	Smart 70 from Golden to Vail	$ (1,000,000)	$ (5,750,000)	$ (3,250,000)	$ (1,200,000)	$ (11,200,000)
Transport	Smart Truck Parking		$ (400,000)			$ (400,000)
Connection	Place Global		$ (20,000)			$ (20,000)
Connection	Blynsy		$ (30,000)			$ (30,000)
Program Support	Consultant Support	$ (300,000)	$ (750,000)	$ (750,000)	$ (750,000)	$ (2,550,000)
Program Support	PR & Marketing	$ (50,000)	$ (150,000)	$ (150,000)	$ (150,000)	$ (500,000)
Program Support	Grant Writing		$ (50,000)	$ (75,000)	$ (50,000)	$ (175,000)
Focus Area	**Proposed Projects**	**Proposed Expenditures**				**Project Total**
Connection	Expand Smart 70 Cellular CV		$ (4,000,000)			$ (4,000,000)
Connection	Smart Roads CV/AV Data Program Blueprint		$ (8,500,000)			$ (8,500,000)
Connection	Fiber Broadband Office with OEDIT			$ (750,000)		$ (750,000)
Sustainability	Ped/Bike Connectivity Challenge		$ (500,000)			$ (500,000)
Safety	Smart Pavement US 285			$ (2,750,000)		$ (2,750,000)
Transport	Smart City Denver I-70 Peleton			$ (2,000,000)		$ (2,000,000)
Safety	Rural Safety Challenge			$ (2,000,000)		$ (2,000,000)
Sustainability	Planning (Also working with DRCOG and Mobility Choice)			$ (1,000,000)		$ (1,000,000)
	Annual Project Expenditures	$ (2,440,000)	$ (25,350,000)	$ (14,775,000)	$ (2,500,000)	$ (45,065,000)
	Budget Leftover for Roll Forward	$ 7,560,000	$ (5,693,475)	$ (8,371,950)	$ 1,224,575	**Total remaining cash of $1.2 million after FY 2018-19 with minimal expenditures during fiscal year**



Questions?