

COLORADO DEPARTMENT OF TRANSPORTATION

Road

Programmatic Support

April 7, 2016

Prepared for
Colorado Department of Transportation



Built to deliver a better world

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April 7, 2016

Peter Kozinski, PE
Director, RoadX Program
4201 E. Arkansas Ave.
Denver, CO 80222

RE: RoadX Programmatic Support

Mr. Kozinski and Members of the Selection Committee:

Through RoadX, CDOT has committed to a bold new path that embraces and accelerates the use of technology to solve increasingly complex and ambitious transportation challenges, now and in the future. To be a sustainable and successful program, CDOT will need to regularly demonstrate RoadX's positive return on investment and progress towards improving urban mobility, rural safety, freight efficiency, and sustainable energy consumption across the state.

AECOM offers unique advantages that increase the opportunity for success in rapidly implementing innovative technology pilot projects in the transportation industry. We are equally vested and enthusiastic about the role that RoadX will play in the future of our local and national transportation system.

Just as you are trying new approaches, AECOM is also employing an innovative approach to this technology opportunity. We are using a leadership structure that is based on AECOM New Ventures—our company's program for focusing on transformation and disruptive transportation initiatives. By committing to this approach, AECOM is recognizing the value of innovation and the role we can play in helping you to accelerate the use of technology in transportation.

Key differentiators of our team include:

- ✓ **Access to Ideas and Experts:** We have mapped our global practice of experts to RoadX and the result is a highly networked, established, and organized team who is ready to serve as thought leaders and innovators. Collaboration and innovation will be led by Alan Eckman, our local single point of contact and RoadX Champion.
- ✓ **Access to Partners and Integrated Implementation:** AECOM offers a partnership network that is unmatched. We have Client Account Managers who have established technology sector relationships and the ability to quickly attract new partners as needed. Our design, build, finance, and operate (DBFO) capabilities encompass all the dimensions that will be required to accelerate implementation.
- ✓ **Access to Collaborative Innovation:** We understand innovation is achieved by pushing beyond our current methods of problem solving. We are committed with you to create a culture in RoadX that effectively opens the pathways to innovation.
- ✓ **C-470 Technology Testbed Corridor:** We have teamed with two firms, Triunity and Cambridge Systematics, who are both involved in the C-470 Corridor. As the recently selected design-build team for the C-470 Tolled Express Lanes project, we provide an opportunity to accelerate the implementation of transformational pilot projects that will improve visibility, customer adoption, and scalability of technology.

1. Administrative Information

We have reviewed the RFP and understand the general scope requirements, consultant responsibilities, non-project specific agreement, and administrative terms that are outlined. We look forward to a successful team chartering that will establish the processes to be used for the program.

2. Conflict Identification

AECOM is a large design, engineering, planning, construction, and related professional services company that executes thousands of projects annually. We do not perceive or anticipate any of our current or past projects to be a conflict of interest on this contract. To be as responsive as possible to the RFP request, we offer the following table that summarizes our relevant contract activity with state agencies and transportation authorities.

AGENCY	SERVICES	DURATION	FEE	ROLE
CDOT Traffic NPS	Studies/Signals/Situator	2012-17	\$3M	Prime
CDOT General Eng. NPS	Infrastructure Design	2014-19	\$5M	Prime
CDOT C-470 TEL D/B	JV Member/Engineering	Pending		Prime Eng.
FDOT D6 ITS Ops	TMC Operations	2007-16	\$48M	Prime
FDOT D4 ITS Ops	TMC Operations	2004 -18	\$50M	Prime
FL TPKE ITS Ops	TMC Operations	2010-20	\$10M	Sub
MDOT SE Michigan	TMC Operations	2005 -18	\$28M	Prime
GDOT RTOP	Arterial Operations	2010-17	\$7.5M	Sub
PADOT ITS Ops	TMC Operations	2016-19	\$2.0M	Sub
SCDOT ITS Ops	TMC Operations	2015-20	\$5.0M	Prime
MDOT Grand Rapid	TMC Operations	2007-17	\$5.0M	Prime
MODOT ITS Ops	TMC Operations	2010-16	\$11M	Prime
MDOT State TMC	TMC Operations	2010-16	\$6.3M	Prime
NCTA TMC Ops	TMC Operations	2009-16	\$3.5M	Prime
VDOT Tunnels	ITS O&M	2013-18	\$9.0M	Sub
FDOT D5 RTMC	RTMC Design	2015-16	\$1.6M	Prime
MDX DMS CEI	CEI of DMSSs	2012-16	\$2M	Prime
LA MTC TMC	ConOps	2015-16	\$150K	Sub
FDOT D6 ITS CEI	CEI of ITS Projects	2013-16	\$1.5M	Prime
FDOT D6 Section 5	CEI of ITS	2010-16	\$2M	Sub
FDOT D7 ITS GEC	Managed Lanes GEC	2014-19	\$1.5M	Prime
LADOTD ITS GEC	Systems	2009- 16	\$1M	Prime
ODOT ATM	ATM Study	2013-16	\$2.5M	Prime
TXDOT ITS	Software, Integration	2009-18	\$20M	Prime
NJ TPKEATMS	Software, Integration	2012-16	\$2.5M	Sub
PADOT ITS GEC	ITS GEC	2012-16	\$3M	Prime
Chicago TSP	Transit Signal Priority	2012-17	\$1.8M	Prime
FHWA Pooled Fund	TMC Research	2002-17	\$1.8M	Sub

AECOM is dedicated to the success of RoadX and look forward to helping CDOT achieve your bold vision and commitment to being a national leader in the use of innovative technology to improve the safety, mobility and efficiency of the transportation system, fostering the continued economic vitality of our state. Please contact Alan Eckman at 303.376.2979 or alan.eckman@aecom.com if we can be of any assistance to you during your review of our submittal.

Sincerely,

AECOM Technical Services, Inc.



Alan R. Eckman, PE, PTOE, MBA
AECOM RoadX Champion



Andrew Liu
AECOM New Ventures



**Alan Eckman,
PE, PTOE, MBA**

▶ 303.376.2979
▶ alan.eckman@aecom.com

"Alan Eckman and the rest of the AECOM team's understanding of the I-70 Mountain Corridor 6-step CSS process as well as proactive communication with the project Stakeholders were critical components to the success of the I-70 Silverthorne project."

- Peter Kozinski, CDOT

1. AECOM RoadX Champion: Access to Leadership & Experience

Collaborative Problem Solving through Innovation & Leadership

Alan was selected as the AECOM RoadX Champion because of his broad background in transportation and business. He is highly networked in the industry as well as within AECOM. He has worked on a variety of challenging and high profile assignments in Colorado over his 18 year career as Principal-in-Charge, Contract Manager, Project Director, Project Manager, and discipline Technical Manager. Alan is a committed leader who works hard to foster a collaborative work environment. He is highly engaged in the success of CDOT, the advancement of Transportation innovation and delivery in Colorado.

As a **Collaborator** Alan has worked with diverse multidisciplinary teams for a broad range of clients on some of the most challenging and publicly visible projects in Colorado.

As an **Innovator** Alan stays connected to thought leaders to vet ideas and bring solutions to the table.

As an **Implementer** Alan is dedicated to seeing ideas become solutions that strengthen programs and projects that he is involved with.

As a **Traffic Engineer** Alan has honed his expertise working with transportation systems focusing on safety, mobility, and economic benefit.

As a **Business Leader** Alan is driven by client service and is externally networked in the industry through ITE, WTS, Denver Chamber, ACEC, ASCE, IBTTA, and ARTBA.

2. The AECOM Team: Access to Ideas and Experts

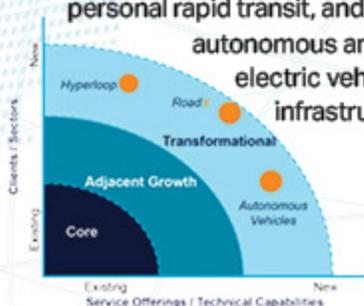
Our Business Model Accelerates Technology in Transportation

Innovation at AECOM is systemic—a value that drives our continued success. With this in mind, AECOM has already shifted our business model; instead of responding to innovation, we are on the forefront of it. As a dynamic company, AECOM leadership is willing to invest in our position as an industry leader. This allows us to bring the best of AECOM to our clients and the industry. Our resources include:

AECOM New Ventures

Led by Andrew Liu, the New Ventures group is focused on transformational growth initiatives that will be disruptive to the marketplace.

Current initiatives focus on new technologies including Hyperloop, personal rapid transit, and autonomous and electric vehicle infrastructure.



AECOM Technology Network

The AECOM Technology Services Catalog is a central repository of technology solutions and capabilities from across AECOM—enabling project teams to leverage the deep technical capabilities and world class technology solutions to deliver work more efficiently and cost effectively.

For example, AECOM's ITS Practice, led by Bob Edelstein, is focused on the complete life-cycle of technology. Innovative strategies encompass ATM, ICM, congestion pricing and connected and automated vehicles applications.

AECOM INKS

We are continuously creating innovative solutions for our clients. Making sure these skills and expertise are networked, the Innovation and Knowledge Share (INKS) team produces the INKS Connect business development newsletter to inspire and share successful innovation case studies and knowledge-sharing projects.

The INKS Team has been developing directly relevant research in autonomous vehicles and connected motorways.





RoadX

AECOM Global Network

We offer a deep and experienced global team with diverse perspectives and expertise, covering the full gamut of transportation services. We are also able to unleash the collective knowledge, and expertise of AECOM's 85,000+ professionals and our client experience—leveraging the unique skills and experience of each individual and their projects.

Small Business/DBE Involvement

AECOM will expand partnerships as needed, but is committed to Small Business/DBE.



Expertise in state-of-the-art communications technology as well as a deep understanding of systems for RTD and other multi-modal integration.



Expertise in freight intelligent transportation systems and design/deployment of technology, big data, and information systems.



Key Staff



Andrew Liu

- ▶ AECOM New Ventures technology leader
- ▶ Relationships with technology/automotive OEMs
- ▶ Transformational Pilot Projects: Hyperloop



Bob Edelstein

- ▶ AECOM's Global ITS Practice Leader
- ▶ ITS project experience in 20 states
- ▶ Shares international ITS best practices



Kyle Williams

- ▶ GIS application development, asset management, and emergency response planning
- ▶ Innovative Project: Qognify's Situator implementation and configuration for CDOT ITS



Brian Keeler

- ▶ AECOM's Manager of ITS Systems Engineering Services
- ▶ Traffic system integration for 10 states, including Colorado



Christopher Hedden (CAMBRIDGE)

- ▶ Policy Analyst of Cambridge Systematics
- ▶ Innovative freight-focused ITS solutions
- ▶ Gateway Cities Tech Plan for Goods Movement PM



John Clem (TRIUNITY)

- ▶ Communications systems and central control systems expertise
- ▶ Technical Lead on DB and P3 transportation projects, including Eagle P3



Deanna Weber

- ▶ Member of AECOM's Sustainable Systems Integration Method (SSIM) team
- ▶ Facilitator for high profile clients to brainstorm robust, innovative, integration ideas



Dan Corey

- ▶ AECOM's Deputy National Practice Leader
- ▶ Implemented technologies for 30+ transportation agencies
- ▶ Member of TRB Vehicle-Highway Automation Committee



3. AECOM Strengths for RoadX: Access to Integrated Implementation with Strong Partnerships

Beyond our people, our strengths include our partnerships and our ability to implement projects from concept to construction.

Access to Partners

AECOM offers CDOT access to our diverse partnership network—connecting you to universities, R&D, big data providers, venture capitalist, technology leaders, systems integrators, telecommunications giants, and automobile manufacturers.



AECOM/IBM developed ATMS for the New Jersey Turnpike Authority and are partnered for India's Smart Cities Challenge-winning the first city: Vizag.

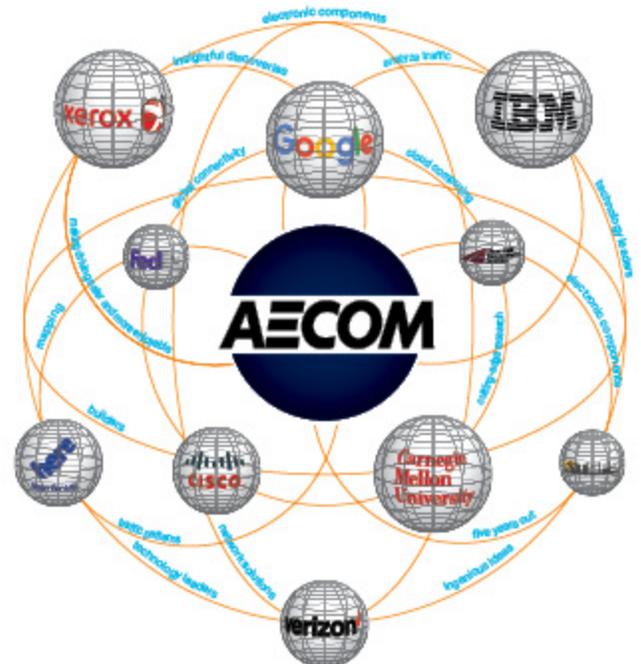


AECOM/Xerox developed and integrated dynamic pricing software for the Los Angeles ExpressLanes Design-Build.



AECOM/Cisco implemented a Smart Parking demonstration for the 2015 California-Nevada Joint Governor's Annual Summit.

AECOM/Verizon has executed 1,500+ diverse projects since 1993. AECOM also partners with Verizon on their Smart Cities products.



Access to Integrated & Accelerated Implementation

As a fully integrated infrastructure firm - spanning all phases of a project's life-cycle - AECOM can implement and help fund projects using the DBFO model.

Design: AECOM has provided planning, design, and implementation support for a wide range of ITS, ATM, managed lanes, and connected vehicles applications throughout the world.

Build: AECOM has successfully built, inspected, and provided oversight of over \$20B in transportation infrastructure.

Finance: AECOM Capital is our investment arm and is a one stop shop for any and all services required to assist in the delivery of Public Private Partnerships (P3) bids and other procurement, refinancing, and development activities.

Operate: AECOM has provided ITS operations in 40+ transportation management centers throughout the US and abroad.

Integrated Implementation Examples



CDOT ITS Qognify Situitor, CO: Kyle Williams is the PM for implementation of this situational awareness software solution that connects decision makers to data to streamline incident response in a collaborative environment.

I-70 EB Peak Period Shoulder Lane, CO: AECOM serves as the CM/GC for this 13-mile project for a widened shoulder to be used as a travel lane during peak times.

North Tarrant Express, TX: AECOM helped fund this 36-mile dynamic tolling/HOT P3 project by providing traffic and revenue forecasts to the concessionaire and in support of \$400M in private activity bonds, supplemented by \$650M TIFIA.

I-64 HOV Reversible Lanes, Hampton Roads, VA: AECOM has been involved in virtually all phases of the 8-mile reversible roadway system. We prepared the design, provided construction engineering and inspection, testing, and provided O&M services for 21 years.





4. Collaboration: Access to Local & National Examples

Both AECOM and Alan Eckman demonstrate a strong commitment to the ideals of collaboration and innovation. We offer a small sampling of demonstrated environments that have required a high-level of collaboration, and then offer a clear approach for achieving the collaborative and innovative outcomes desired by RoadX.

AECOM Team: Collaboration Examples



Illinois Tollway
Connected Vehicles

Collaborative Approach: AECOM is designing receiver spots on the freeway where they will collect vehicle data (e.g., speed, windshield wiper, location, etc.) and initially use it for ramp queue detection and smart work zones. **Outcome:** The program will develop a connected vehicle vision, communications (including DSRC) installation, probe vehicle opportunities, and outfitting Tollway vehicles with aftermarket connected vehicle devices.



New Zealand Connected
and Automated Vehicles

Collaborative Approach: AECOM is investigating New Zealand's technical readiness to support the deployment of automated and connected vehicles. This research is focused on the necessary infrastructure, technologies and systems to support level three and four vehicle automation and connected vehicles. **Outcome:** Estimates will be made with regards to automated vehicle penetration within different timeframes as well as roadway infrastructure requirements.



Georgia DOT
Navigator TMC

Collaborative Approach: AECOM/Bob Edelstein collaborated with the Georgia DOT, State Toll Road Authority, and other operational partners in developing a ConOps and design plan for the Georgia Navigator TMC. **Outcome:** A redesigned and reconstructed TMC—making use of shared pods to facilitate operational synergy among the partner agencies.

Alan Eckman – AECOM RoadX Champion: Collaboration Examples



Innovative Infrastructure
Role, I-70/Silverthorne

Collaborative Approach: Alan/AECOM and the CDOT leadership team implemented a collaborative alternatives approach using CSS principles, an agency/stakeholder PLT, and effective public communication strategies. **Outcome:** Collaborative recommendations that included a series of well communicated and stakeholder endorsed construction packages that included a Diverging Diamond Interchange conversion that requires less than \$6M.



Innovative Leadership Role,
Denver Strategic Plan

Collaborative Approach: Alan/AECOM was the lead PM for assembling the final transportation plan, which involved collaboration with 10+ consulting firms, and DRCOG, RTD, CDOT who contributed to the Citywide technical analysis. **Outcome:** Implementation of a balance of behavioral, operational, and physical improvements and established basis for priorities in citywide investment. *"The final product is one which the Department of Public Works and the City are very proud"* - Ms. Crissy Fanganello



Innovative Business Role

Collaborative Approach: Alan leads transportation business development in the largest multidisciplinary Colorado engineering practice. He collaborates throughout the AECOM local and global practice to bring the best people and innovative ideas to our clients. **Outcome:** Delivery of hundreds of projects and programs, ranging from major to minor for Colorado clients: CDOT, CCD, RTD, DEN, Colorado Springs, Fort Collins, Pueblo, and many other local and federal agencies located in Colorado.



AECOM Collaboration Advantages for RoadX



Innovation | AECOM offers capability in both transformational and evolutionary innovations. Revolutionary innovations are “disruptive game changers” that set a whole new path. Evolutionary innovations are incremental tactical improvements to existing methods.



Collaborative Partnerships | AECOM offers an unparalleled level of partnerships including public sector academic and research applications with Carnegie Mellon, Texas Transportation Institute, and the Milken Institute. We also bring partnerships with automotive OEMs, IBM, Google, and Verizon.



Commitment | Our 50 year history with CDOT serves as the foundation of our ongoing commitment. We have helped CDOT roll-out other innovative/non-traditional programs including Bridge Enterprise, Flood Recovery Office, Office of Major Project Development, and Portfolio Cash and Office of Program Management.



Resources | AECOM offers vast and nearly boundless resource opportunities with a global staff of over 85,000, access to capital and finance, and the ability to design, build, operate, and maintain solutions.

AECOM Approach to Collaborative Innovation: 30 Day Start-up Recommendations



Proven Collaboration



CDOT 2013 Flood Recovery & Resiliency

By focusing on outcomes-based goals through collaborative planning and allocating work according to technical skill/capacity, the blended flood team of multiple consultants and CDOT staff responded to disaster without pause.

C-470 Technology Testbed for Innovation Technology, Data Use & Systems Integration

The AECOM Team Advantage

AECOM was recently selected as the C-470 Tolled Express Lanes Design-Build Team, which offers CDOT an opportunity to rapidly implement technology in the corridor. Our selected partners in Triunity and Cambridge Systematics have also been active in the C-470 corridor and offer value-added history and system/communication integration expertise. We have highlighted several ideas, with one idea standing out as transformational and disruptive.

TETHERED SEMI-AUTONOMOUS SNOW PLOW

The corridor can provide an opportunity to test the unmanned snow plow/pavement treatment tanker tethered to a manned snow plow through vehicle to vehicle technology. The demonstration could attract various OEM's or suppliers to demonstrate proof of concept for CDOT fleet vehicles.

SMART FREIGHT DATA/SYSTEMS

C-470 has a relatively low share of truck traffic, but the connecting local system is critical to commercial travel. The local streets and regional arterials are most heavily utilized by commercial vehicles serving businesses, residents, and logistics hubs. Installation of sensors and real-time information systems, along C-470 and connecting routes will provide accurate information on travel conditions, load matching, and wait times for connections to corridors and major intermodal facilities. This systematic approach will help eliminate off-system bottlenecks, improve access to freight destinations, and reduce delay from truck-related incidents in peak periods.

FREIGHT PERMITTING/SECURITY

As Express Lanes are completed along the C-470 corridor, tolling infrastructure can also be utilized to test emerging technologies related to freight vehicle enforcement, permitting, security, and information dissemination. Additional installation of toll gantries, monitoring systems, and sensors can leverage this corridor to double as a real-world test bed for freight technologies that can help to increase uniformity in the industry.

DYNAMIC MERGE CONTROL

This ATM strategy dynamically changes lane allocation at interchanges based on mainline and entering or exiting ramp volumes. This strategy allows a ramp to have one or two lanes depending on the demand on the ramp and mainline volume. This idea could be implemented at an interchange on C-470 with variable peak traffic (for example, shopping seasons) and potentially to throttle entry/exit of the Express Lanes. This pilot idea could be tested on C-470 and scalable to other locations such as at key downtown interchanges with heavy event traffic.

USING DATA FOR INTEGRATED SITUATIONAL AWARENESS & OPERATIONAL SYSTEMS

AECOM can accelerate full use of data and equipment to a high level of customer and operational benefits by using Qognify Situator Platform: 1) Operators using Situator will view ITS device locations on a map along with additional data that feeds into traffic patterns. 2) Queuing will be identified at onset so early mitigation can occur, reducing congestion and potential safety hazards. 3) Live and forecasted weather data will be overlaid on current traffic conditions to identify areas of potential risk. 4) Historic accident data will be displayed to visualize accident correlation and trending. 5) Time of day/time of year data will be displayed to understand potential long term trends. 6) Device location for mitigating incidents (patrol vehicles, tow trucks, snow plows, etc.) will be displayed to show proximity and expected response time.

SAFETY & CONGESTION| PREDICTIVE MODELLING

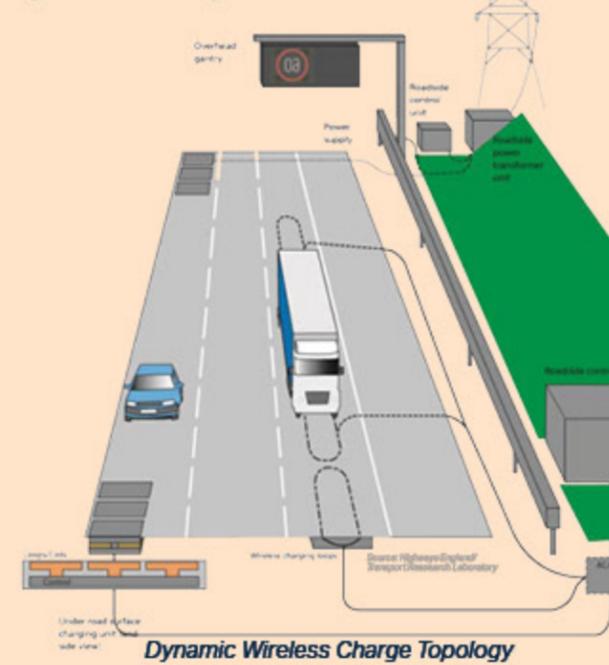
Similar to the predictive modelling AECOM and IBM provided for the New Jersey Turnpike, this idea leverages CDOT's existing data capture devices (traditional and DSRC). The road condition and traffic information collected can be used in a predictive modelling application for congestion and potential safety risk and then shared with others (Waze, Google, third-party developers) to disseminate to the motorists. If the pilot is proved, this solution can be expanded to include the entire C-470/E-470/NW Parkway road system to further optimize the solution and improve road safety.

DYNAMIC ROADWAY ELECTRIFICATION & ELECTRIC VEHICLE DEMONSTRATION PARTNERSHIPS

Colorado-based UQM Technologies has been in the business of vehicle electrification for over 40 years. UQM maintains a line-up of EV propulsion systems that have been successfully deployed in applications from passenger vehicles to 40-ft buses – including with Proterra Bus Company. AECOM with UQM can bring a wide network of EV integrators to produce a world class EV demonstration for the pilot project. Data feedback from the pilot project could attract the best component suppliers in the industry with the most experience in electric vehicle controls, energy and battery management.

AECOM Transformation & Disruptive Pilot Project Idea

Dynamic Roadway Electrification



PROJECT OVERVIEW

Technologies that eliminate range anxiety for EVs will further accelerate growth of the market, and current innovations to address the range anxiety problem include supercharging systems and dynamic roadway electrification. There is still room for disruption in dynamic roadway electrification to emerge as the winning solution for EV recharge. By installing a pilot project to test different roadway electrification technologies, Colorado becomes a proving ground for a truly disruptive infrastructure technology that could be deployed across the US and globally.

ATTRACTING PARTNERS

Dynamic roadway electrification projects are a natural business model innovation for DOT agencies, utility companies, and automotive OEMs. The time is now to be synchronous with the 30-year horizon for EV and plug-in hybrid market penetration. CDOT could partner with Xcel Energy to develop projects with a power purchase agreement, providing a winning

solution for both parties. CDOT would receive a subsidy from the utility for the right to use infrastructure and the utility would generate a new source of revenue. CDOT could also deploy the same business model innovation for placement of 5G or DSRC installations with telecom partners. Finally, automotive OEMs would have interest in participating to test the viability of dynamic roadway electrification for their EVs. C-470 is an ideal testing ground with the variety of climate conditions, and DSRC provides instrumentation for data collection.

RAPID IMPLEMENTATION

Pilot testing is more expensive on existing roads due to additional costs of traffic management and trenching for both the technology itself, and for cables and roadside cabinets. As the recently selected Design-Builder for C-470, AECOM has the unique opportunity to reduce costs of a pilot project by installing the charging technology into new lanes.

THE NUMBERS

Using a cost ratio provided by a California-based technology company for rolling contact systems, the cost for installation during construction of a new roadway would be roughly 25% of the cost for installation on existing roadway; or roughly \$1.25M per mile for induction charging. The comparative cost for the rolling contact system could be as low as \$125k per mile for equipment only. Based on these cost estimates, CDOT could install a one-mile line induction charging roadway (\$1.25M/mile) and a six-mile long rolling contact charging roadway (\$125k/mile) into the new C-470 project for \$2M. By leveraging investments from potential utility partners and OEM partners, CDOT could increase the length of the induction charging roadway beyond one-mile. CDOT would be setting a new innovation pathway to the future with this innovative technology testbed.



WHAT MAKES THIS A GREAT PILOT PROJECT?

- ▶ **Attractiveness to Partnerships/Funding:** Potential with Xcel Energy, vehicle manufacturers, and RTD commuter routes
- ▶ **Degree of Scalability:** Potential to extend/partner with E-470 for a longer continuous charging lane
- ▶ **Visible and Impactful to the Customer:** Can be marketed and showcased by CDOT
- ▶ **Reduces Capital Investment Compared to Traditional Solution:** Relatively low cost per mile in new lanes
- ▶ **Creates Multi-State or Regional Opportunities:** Sharing research helps to expand the concept
- ▶ **Improves Business and Economic Vitality:** Positions Colorado as an EV leader
- ▶ **Accelerates Adoption:** Reduces EV barriers



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