

SUBMITTED TO:  
Hyperloop One

**AECOM**

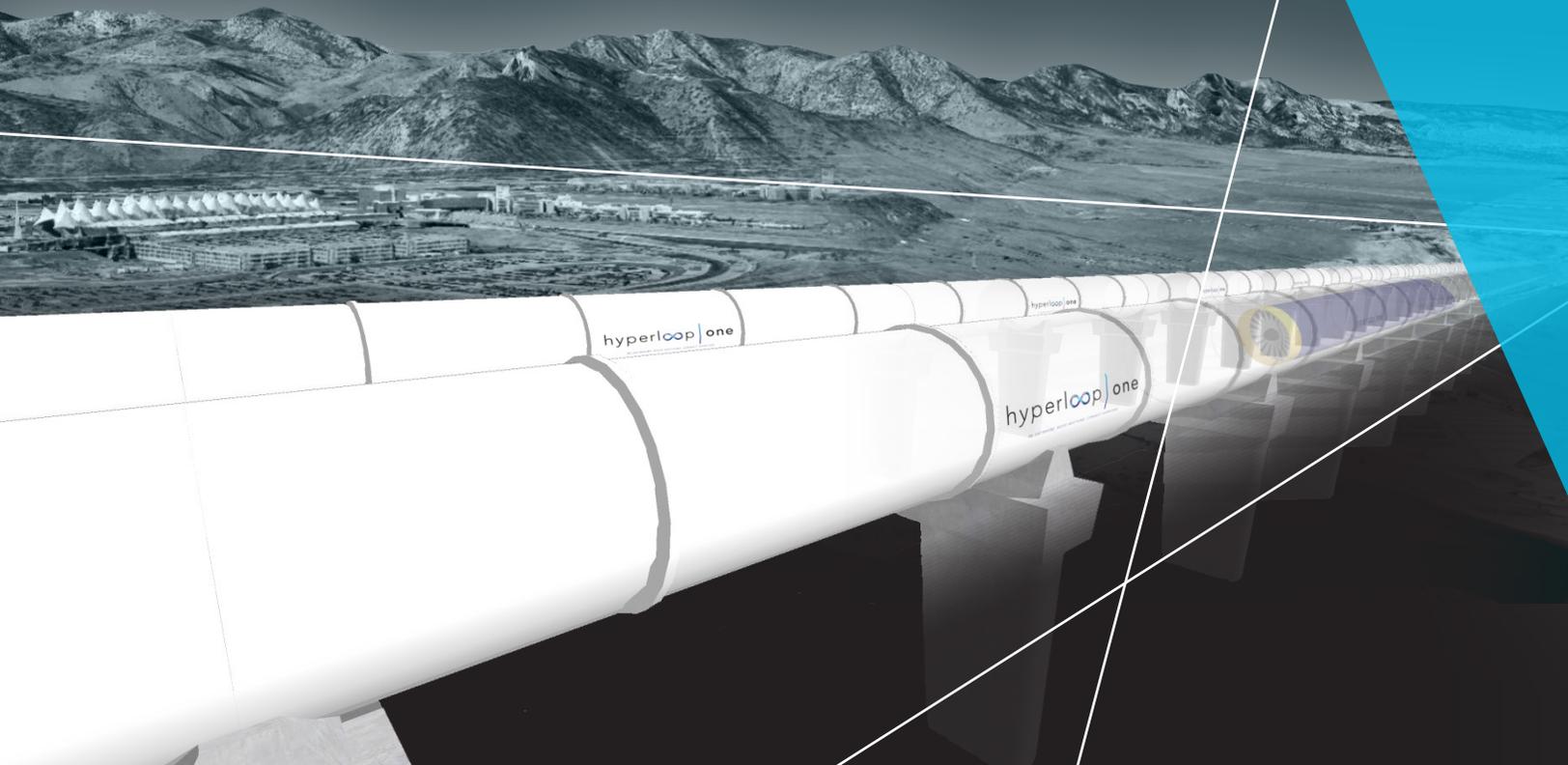
Built to deliver a better world

IN PARTNERSHIP WITH:  
Colorado Department of Transportation  
City and County of Denver  
Denver International Airport (DEN)  
City of Greeley

# ROCKY MOUNTAIN HYPERLOOP

## Global Challenge

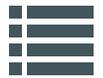
October 2016





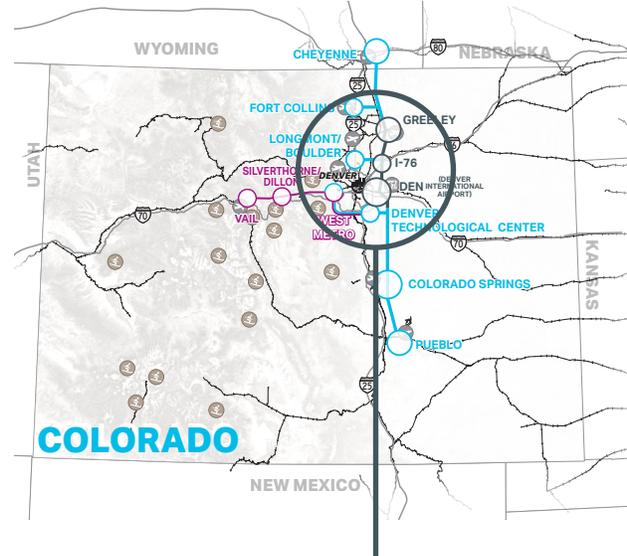
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# Entrant Details



## THE PROPOSING **TEAM AND PARTNERS**

The Rocky Mountain Hyperloop team includes the Colorado Department of Transportation/RoadX (CDOT) and global infrastructure firm AECOM as primary sponsors, in concert with the City of Greeley in northern Colorado and the City and County of Denver/Denver International Airport (DEN). These are the initial partner agencies for the proposed 40-mile (64-km) Accelerated Phase 1 Hyperloop.



## THE PROPOSED ACCELERATED PHASE 1 HYPERLOOP

The proposed Hyperloop is a comprehensive system that links the Colorado Front Range urban areas and the mountain recreation areas to the west. Accelerated Phase 1 Hyperloop is anchored by DEN on the south and the City of Greeley to the north.

### DEN and Denver Metro Area

DEN is the 6th busiest airport in the US with more than 54 million passengers traveling through the airport each year. The airport is the primary economic engine for Colorado, generating more than \$26 billion for the state, annually. A Hyperloop hub at DEN will accelerate realization of the visionary Aerotropolis program, and bring unparalleled efficiencies to the overall industry supply chain and increased accessibility to passengers. DEN links seamlessly to the broader Denver metropolitan area, which is nearing 3 million in population and rapidly growing.

### City of Greeley and Northern Colorado

Greeley is a major city of the Front Range Urban Corridor and the most populous municipality of Weld County. Its diverse employment base includes energy (e.g., wind and solar), agriculture, business support, education, and advanced manufacturing centers. An Accelerated Phase 1 Hyperloop hub at Greeley will provide invaluable connectivity to northern Colorado communities, which are among the fastest growing metropolitan areas in the nation.

### Key Benefits of Accelerated Phase 1 Hyperloop:

- Low complexity and cost
- Development and value capture potential from “greenfield” transformative opportunities
- The “Arc of Innovation” that results from connecting highly diverse economic industry clusters
- New gateways and enhanced existing gateways to the world market through DEN
- A new travel paradigm for the fastest growing region of northern Colorado

## Hyperloop will create an “Arc of Innovation” by **Connecting Diverse Economic Industry Clusters**



## REVENUE POTENTIAL AND **COMPETITIVE COST OPPORTUNITY**

**Ridership:** Rocky Mountain Hyperloop is estimated to attract 28 million trips in 2020, rising to approximately 45 million trips by 2040. Accelerated Phase 1 alone would generate an estimated ridership of 5 million trips in 2020, and more than 10 million trips in 2040.

**Revenue:** The Rocky Mountain Hyperloop system is estimated to generate gross revenue of approximately \$1.3 billion per year in 2020, and \$2.0 billion per year in 2040.

**Value of Time Savings:** The value of time savings per year generated by Hyperloop is estimated at \$470 million in 2020 and \$780 million in 2040.

**Emissions Savings:** The estimated savings in emissions from Hyperloop is \$4.1 million per year in 2020 and \$9.6 million per year in 2040. This is equivalent to the avoidance of 65,000 and 105,000 metric tons of carbon dioxide entering our atmosphere in those respective years.

**Capital Expenditure:** The estimated cost of developing the infrastructure of Accelerated Phase 1 of the Rocky Mountain Hyperloop is \$3 billion. Development of the entire network is estimated at \$24 billion. This estimate includes land acquisition; development of stations, intermodal facilities, and maintenance/storage yards; and gliding stock.

**Opportunities the Rocky Mountain Hyperloop can leverage to achieve comparatively lower development costs include:**

- **Low cost of rural land with a majority of flat terrain**
- **Proximity and accessibility to mature pre-fabricated manufacturing capabilities**
- **Plentiful access to heavy rail, highways, and manufacturing workforce**

## WE ARE AGENTS OF **CHANGE AND INNOVATION**

The proponents of this proposal have united to put forth a market-ready concept to implement Hyperloop. This opportunity is viewed as our 21st century transportation legacy for future generations. Since the beginning of our state, we have demonstrated a strong connection between transportation innovations and the success of the state and region. We see Hyperloop as extending this history and catalyzing the next wave of transportation-related transformative opportunities.

### AN EXTRAORDINARY HISTORY DELIVERING THE VISION FOR THE FUTURE

Infused with the same pioneering spirit of the generations that carved Colorado cities from the Rocky Mountains, we have a vision for an even greater state. Our approach of pairing the newest technologies and strategies with regional public and private collaboration has made Colorado what it is today and provides the base for our next leap in securing mobility freedom for our residents. It is auspicious that approximately 100 years after the traditional vehicle was readily available to the average citizen, the next generation of transportation could be deployed in Colorado.

Over the past 25 years, we have made strategic leaps in our transportation policies and investment that have transformed the state:

- **CDOT's RoadX Program**

RoadX is CDOT's bold program to be a national leader in the use of innovative technology to create crash-free, injury-free, delay-free travel. This technology focus and synergy with Hyperloop will work effectively together to transform travel in Colorado.

- **Regional Transportation District (RTD) FasTracks**

Colorado voters approved the multi-billion dollar metropolitan-wide light rail, commuter rail, and bus rapid transit (BRT) system that will provide an unsurpassed passenger connection and distribution system for Hyperloop. Various accelerated alternative delivery methods were used including design-build-finance-operate-maintain (DBFOM) public-private partnerships (P3s).

- **City and County of Denver's Vision for a Smart City**

Denver has been selected to receive a \$6 million grant from the US Department of Transportation to create more sophisticated traffic management centers, relieve freight congestion, and enhance pedestrian safety.

**The success of these programs and projects demonstrates that we are able to align our policies, resources, and regulations to deliver transformative transportation projects, and we will bring this approach to making Hyperloop a reality in Colorado.**

## A Compelling and **Comprehensive Rationale**

**Corridor** - The proposed Rocky Mountain Hyperloop system would connect 85 percent of Colorado residents, and the principal economic generators of the state.

- The introduction of Hyperloop to the Front Range will not only dramatically transform the key economic, social, and environmental characteristics that currently define the region; it will also support more sustainable and strategic options for managing future growth.
- DEN is the central hub of passenger movement, a direct link to the Denver metropolitan area through the A Line transit corridor, and a center of logistics and Smart City development.
- Hyperloop would provide a high efficiency link from the global markets served by DEN and the fastest growing areas of northern Colorado.

**Transformation** - Hyperloop will enhance the region's economic competitiveness by improving accessibility and connectivity between its industry clusters, knowledge infrastructure, and the workforce.

- Fast, efficient intraregional transportation coupled with a diverse, resilient, and technology-driven economy will continue to attract business.
- Hyperloop will leverage this region's competitive strengths in bioscience, health services, advanced manufacturing, and science-led agribusiness with proximal federal laboratories and universities—resulting industry clusters enabled by quick transportation to DEN for air freight to domestic and international destinations.
- Hyperloop's introduction and operation will augment the Front Range's Gross Region Product (GRP) by an estimated \$25 billion per annum, or about 7 percent by 2040.

**Passenger & Cargo Flows** - Hyperloop would transform the Front Range into a 200-mile-long mega-region and economic powerhouse with easy access to some of the most beautiful natural resources in the world.

- Hyperloop's extremely efficient travel times offers completely new opportunities for intercity and regional transport for both passengers and cargo. By effectively linking Hyperloop stations with local transportation systems, whole new areas of economic development and regional interconnectivity can flourish.
- The intrastate rail market that could be served by Hyperloop includes 9.3 million tons or 84,813 loads per year at a value of \$700 million.
- The Hyperloop would be four times faster than high speed transit and 12 times faster than express bus options studied in the I-25 corridor. Hyperloop would reshape travel patterns and transportation in the region.

**Government & Policy** - Colorado has historically used innovative project delivery methods across all modes of transportation infrastructure. This is mainly due to a conducive legislative environment and broad citizen support.

- Colorado has led the use of several innovative means of alternate delivery, including P3s.
- Supportive programs ranging from the Colorado Energy Office and the CDOT RoadX Program will be highly beneficial to the development of Hyperloop.
- The value of time in Colorado is higher than the national average; this increases the willingness to pay for transportation options such as Hyperloop.

**Acceleration** - The Rocky Mountain Hyperloop will require close collaboration between the public and private sectors comprising a suite of P3s, all working towards the long-term outcome of developing, operating, and maintaining the Hyperloop and integrating it into the fabric of the transportation system.

- Hyperloop will leverage experience of Colorado's agencies with successful implementation of P3s for major infrastructure projects.
- We will use Planning and Environmental Linkages (PELs) and Environmental Assessment (EA) templates to accelerate the regulatory review process and secure stakeholder consensus early.
- Hyperloop will attract private investment through implementation of complementary region-wide economic development and land use policy (e.g., establishment of special economic zone near DEN) that will both incentivize investment and facilitate value capture from new growth.

## Support for the **Proposal**

The proposing team has coordinated and developed strong partnerships that will forge the path for Hyperloop in Colorado. These partners are not only open to the project, but are excited and committed to the potential it will deliver for the future of Colorado and the world.

### **SHAILEN P. BHATT** EXECUTIVE DIRECTOR, CDOT

*“We are excited about the opportunity to provide the progressive perspective that Hyperloop One brings—it will change our customers’ current perception of transportation, and as a result, revolutionize what we think we know. We have made a bold commitment to our customers to be a national leader in innovative technology that improves our transportation system. The Hyperloop technology directly aligns with our goals of reducing the cost of transporting goods; of turning rural state highways into zero death roads; and of decreasing congestion within Colorado’s critical corridors.”*

### **MICHAEL B. HANCOCK** MAYOR, CITY AND COUNTY OF DENVER (OWNER/OPERATOR OF DEN)

*“On behalf of the City and County of Denver, I am writing to voice my support for Colorado to host the first Hyperloop network and be a part of the future of travel. I am confident that this new and transformative method of transportation will bring substantial benefits to Colorado and the West.*

*We pride ourselves on intergovernmental and regional cooperation to be the nation’s leader in technology and economic innovation, and we welcome the opportunity to host a project with the potential to dramatically advance the nation’s transportation system.”*

### **THOMAS E. NORTON** MAYOR, CITY OF GREELEY

*“The proposed Rocky Mountain Hyperloop aligns with the industrial and commercial development planned on Greeley’s wide open plains at the eastern edge of our City. Hyperloop technology provides an unbelievable opportunity for all of northern Colorado, and for Greeley in particular, at only 40 miles from Denver International Airport, to continue to be the business hub for northern Colorado, providing goods and services to people throughout the region.*

*The City of Greeley endorses Rocky Mountain Hyperloop and welcomes the transformation this amenity will bring.”*

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## The Rocky Mountain Hyperloop Corridor Vision



## HYPERLOOP | FRONT RANGE URBAN CORRIDOR

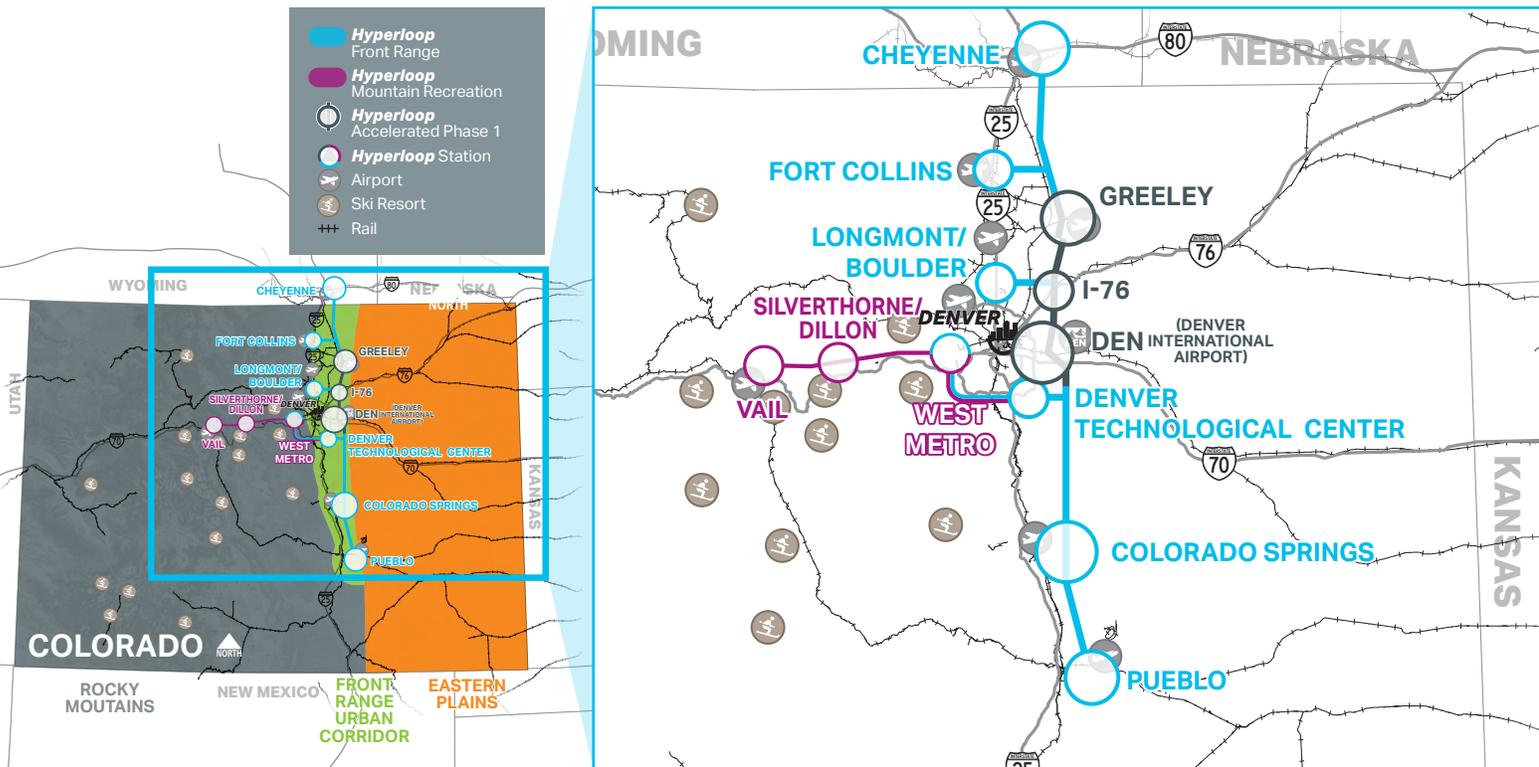
The Front Range Urban Corridor is located along the eastern face of the Rocky Mountains, encompassing 18 counties in the US states of Colorado and Wyoming. The urban corridor would include a 250-mile (403-km) north-south line moored at DEN and extending north to Cheyenne, Wyoming, and south to Pueblo, Colorado. The Front Range Urban Corridor is anchored by Denver, the state's capitol and largest city. In addition to Denver, numerous other major population centers are located along the Front Range. With the rapid pace of population growth and land development, these major urban centers have become one megatropolis. Hyperloop would accelerate this evolution and better connect centers of activity and industry.

## HYPERLOOP | ACCELERATED PHASE 1

A logical first phase for the Rocky Mountain Hyperloop is a 40-mile (64-km) route from DEN to Greeley. This first phase could be accelerated by taking advantage of Colorado's "greenfields," which offer fewer complications in terms of alignment and rights-of-way, and a connection to the highest growth areas of northern Colorado.

## HYPERLOOP | MOUNTAIN RECREATION

The second line of the Rocky Mountain Hyperloop would add 75 miles (121 km) of guideway west of the Denver metropolitan area into the mountain recreation areas. Every year the scenic areas and recreational opportunities of the Rocky Mountains draw millions of tourists. It would facilitate travel for Front Range residents—a large portion of the mountain recreation market—to the mountain areas. Hyperloop would also serve out of state tourists who arrive in Colorado via DEN.



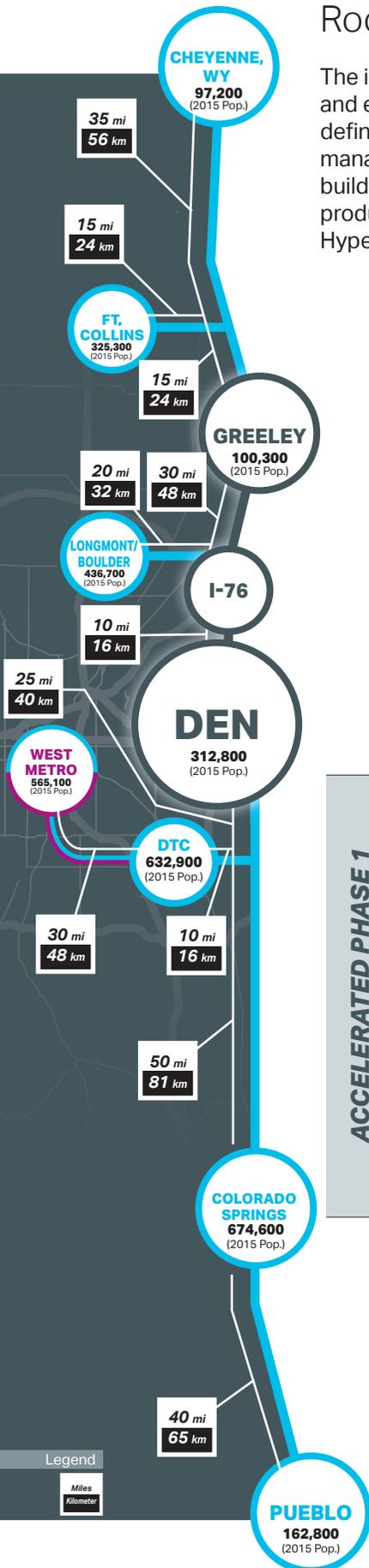
## BASIS AND BENEFITS OF THE ROCKY MOUNTAIN HYPERLOOP SYSTEM

The proposed network is based on extensive previous studies that provide a strong basis for the proposed network. Front Range high speed rail from Fort Collins to Pueblo was examined by the Interregional Connectivity Study (ICS). The Advanced Guideway Study (AGS) examined fixed guideway passenger systems into the mountain recreation areas along I-70, with a special focus on non-tractive force technologies. The Hyperloop two-line network would serve 85 percent of Colorado residents and a portion of Wyoming residents. The Mountain Recreation Corridor would

primarily serve tourism travel into the mountains, a significant portion of the Colorado economy. The Wyoming extension is envisioned to facilitate cargo intercepts with the main east-west cargo corridor along the Class I railroads and I-80. The north-south Front Range Corridor would primarily serve employment and other trips associated with the principal economic activity of the Front Range. It would also serve high value cargo entering and leaving the state at DEN. Twelve stations are envisioned for the full 360-mile (580-km) network with three stations in the Accelerated Phase 1.

# Rocky Mountain Hyperloop *Front Range Stations*

The introduction of Hyperloop to the Front Range will not only dramatically transform and enhance the key economic, social, and environmental characteristics that currently define the region; it will also support more sustainable and strategic options for managing future growth. It will be a mechanism that enables the region's economy to build on current strengths to develop and advance centers of innovation and high value production. Coupled with the development of Aerotropolis and future expansions of DEN, Hyperloop will increase the region's export capabilities and capacities significantly.



## WHY THIS STATION? POPULATIONS/EMPLOYMENT CENTERS

<p><b>CHEYENNE, WY -</b> Interstate and Rail Cargo</p>	<ul style="list-style-type: none"> <li>Facilitates cargo connections with major east-west routes (I-80 and Class I railroad [Transcontinental railroad] and intermodal facility)</li> <li>Major food and goods distribution hub</li> </ul>	
<p><b>FT. COLLINS -</b> Advanced Industry and University</p>	<ul style="list-style-type: none"> <li>Well established industry clusters in aerospace, advanced manufacturing, bioscience, agriculture, beverage, and information technology, all tied to the Colorado State University powerhouse</li> <li>Ties to nearby industry growth opportunities and communities such as the Town of Wellington</li> </ul>	
<p><b>LONGMONT/BOULDER -</b> Knowledge Driven Economy and National Labs</p>	<ul style="list-style-type: none"> <li>Highly educated workforce, National Oceanic and Atmospheric Administration (NOAA), National Institute of Standards and Technology (NIST), National Center for Atmospheric Research (NCAR) and the University of Colorado</li> <li>Renewable energy, bioscience, aerospace, and outdoor recreation</li> </ul>	
<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><b>ACCELERATED PHASE 1</b></p>	<p><b>GREELEY -</b> Agriscience and Energy</p>	<ul style="list-style-type: none"> <li>Home to the University of Northern Colorado</li> <li>Boasts one of the largest renewable energy clusters in the US</li> <li>Colorado's agricultural industry hub and one of the nation's largest exporters of beef</li> </ul>
	<p><b>INTERSTATE 76 -</b> Interstate and Rail</p>	<ul style="list-style-type: none"> <li>Intercepts cargo traffic at I-76 as northern Denver gateway and Class I railroad into Nebraska and further east</li> <li>Hub of industry and development opportunity at interchange area</li> </ul>
	<p><b>DEN -</b> Airport Link to the World</p>	<ul style="list-style-type: none"> <li>Access point to RTD transit system, single largest employer in Colorado, and nearly 160,000 passengers each day</li> <li>6th busiest airport in the US, 19th busiest airport in the world</li> <li>Largest economic engine in Colorado, contributing more than \$26 billion to the state's economy annually</li> <li>Global access to the region's imports/exports and a focal hub for manufacturing, logistics, and distribution</li> </ul>
<p><b>DENVER TECHNOLOGICAL CENTER (DTC) -</b> Aerospace and Engineering Hub</p>	<ul style="list-style-type: none"> <li>Competitive advantages in education, aerospace, and advanced manufacturing</li> <li>Top ranking center for private aerospace employment and 3rd largest aerospace economy in the US</li> </ul>	
<p><b>COLORADO SPRINGS -</b> Military, Aerospace, and NORAD</p>	<ul style="list-style-type: none"> <li>US Strategic Air Command, US Air Force Academy, 100 aerospace/defense companies</li> <li>200+ high tech companies</li> </ul>	
<p><b>PUEBLO -</b> Logistics and Manufacturing</p>	<ul style="list-style-type: none"> <li>Manufacturing (e.g., home to Vestas [wind turbines])</li> <li>Major food and goods distribution hub</li> <li>Surrounded by agriculture</li> </ul>	

# Rocky Mountain Hyperloop *Recreation Stations*

Colorado's ski and outdoor recreation industry generates more than **\$4.8 billion annual** economic impact, comprising a significant portion of the state's tourism and recreation sectors and supporting a sizeable share of the employment and tax base in the mountains.



**VAIL**  
42,600  
(2015 Pop.)

**SILVERTHORNE/  
DILLON**  
14,900  
(2015 Pop.)

**WEST  
METRO**  
565,100  
(2015 Pop.)

50 mi  
81 km

30 mi  
48 km

25 mi  
40 km

Legend



	WHY THIS STATION?	POPULATIONS/EMPLOYMENT CENTERS
<b>ACCELERATED PHASE 1</b>	<b>DEN –</b> Conduit between mountain recreation and national/international destinations	<ul style="list-style-type: none"> <li>• Hub of connectivity to the recreation corridor along I-70</li> <li>• Skier visits account for 600,000+ arrivals at DEN, or 8 percent of all non-connecting arrivals to DEN</li> </ul>
	<b>WEST METRO –</b> Link between Mountain West and Front Range Industry	<ul style="list-style-type: none"> <li>• Hub of beverage production, one of the fastest growing industries in the Denver Metro</li> <li>• Industry focused on clean energy and engineering, with National Renewable Energy Laboratory (NREL)</li> </ul>
	<b>SILVERTHORNE/DILLON –</b> Connects all of Central Colorado	<ul style="list-style-type: none"> <li>• Gateway to Summit County (with 5 ski areas less than a half-hour drive) and much of Western Colorado</li> <li>• The first metropolitan area west of the Continental Divide along I-70 at the intersection of Highway 9</li> </ul>
	<b>VAIL –</b> Recreation Industry and Regional Airport	<ul style="list-style-type: none"> <li>• Encompasses two world renowned ski areas—Vail and Beaver Creek—which serve as major employers, has significant tourism and recreation-based industries, and links to national destinations through the Eagle County Regional Airport</li> </ul>

## Benefits of Rocky Mountain Hyperloop *Accelerated Phase 1*

Accelerated Phase 1, including the stations and the mainline alignment, offer a number of key advantages. This segment would provide a high efficiency link from the global markets served by DEN and the fastest growing areas of northern Colorado.

### Connectivity of Transport and Development

From a station perspective, DEN would be the central hub of passenger movement, a direct link to the Denver metropolitan area through the A Line transit corridor, and a center of logistics and Smart City development. An intermediate station at I-76 would open the door to interstate commerce access as well as high-intensity population and employment growth. The northern terminus at Greeley would provide a link to agribusiness, industrial commerce, and renewable energy, and serve as a geographical gateway to northern Colorado communities and centers of specialized industry.

### Feasibility of Acceleration

The Accelerated Phase 1 alignment offers a path of least resistance in terms of property impact. The alignment crosses primarily open lands with farmlands and oil fields. It is anticipated that regulatory clearances and approvals would be streamlined as compared to corridors crossing compact, urban areas. The relative cost of implementation would also be lower than in areas where more significant infrastructure adjustments would be necessary.

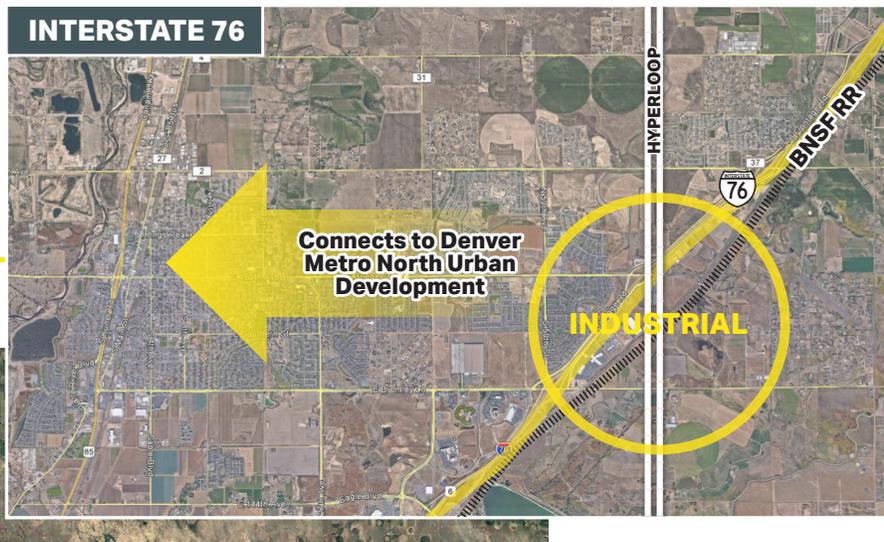
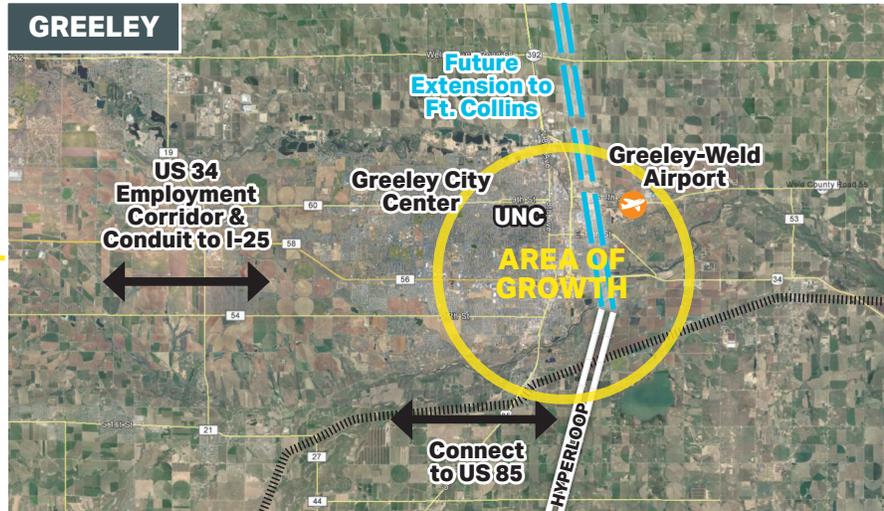
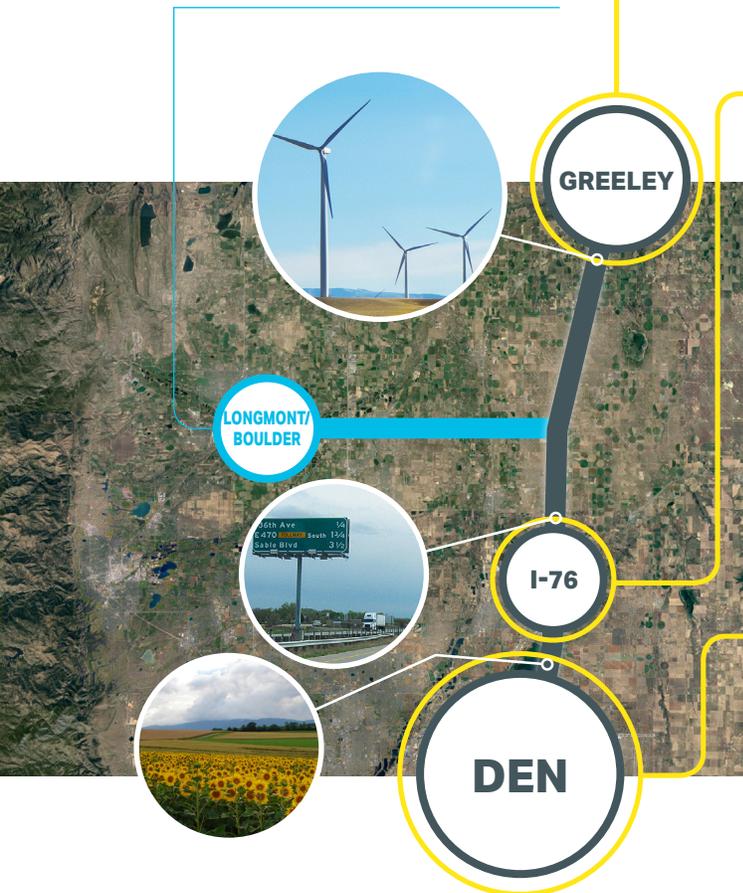
# Rocky Mountain Hyperloop Accelerated Phase 1 ROW Detail

The termini for Phase 1 are DEN to the south and Greeley to the north. I-76 serves as an intermediary station with optimal interstate rail and highway connectivity. The primary base of operations would be from DEN. Autos, transit, ridesharing, autonomous vehicle network, and automated cargo loading would provide access and distribution from stations.

## RIGHTS-OF-WAY

The 40-mile (6-km) Accelerated Phase 1 alignment between DEN and Greeley is relatively flat across primarily undeveloped lands. Crossing I-76, the Class I rail road, and the Platte River are the main constraints in Phase 1. Opportunities for the three Phase 1 stations are shown in the accompanying illustrations. These depict sufficient available land for the Hyperloop stations and associated long-term development potential in and near each station area.

*The Longmont/Boulder area offers an important population and employment cluster that could link to Phase 1.*



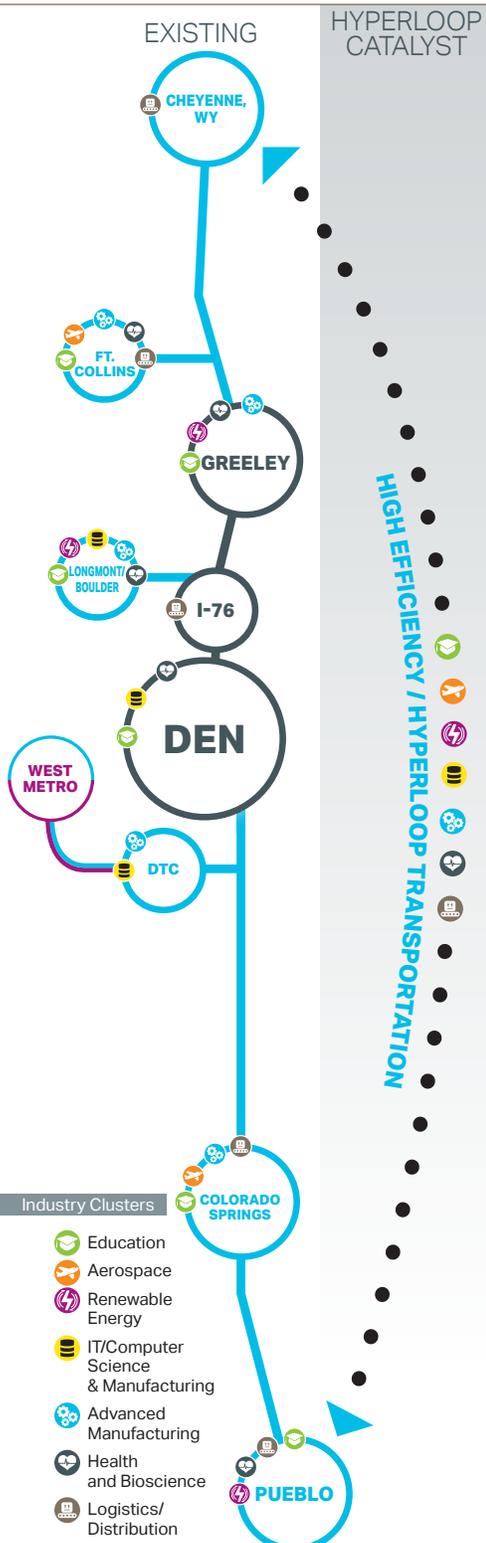
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## Strategic Transformation



## Rocky Mountain Hyperloop *Front Range Stations*

The introduction of Hyperloop to the Front Range will not only dramatically transform and enhance the key economic, social, and environmental characteristics that currently define the region; it will also support more sustainable and strategic options for managing future growth. It will be a mechanism that enables the region's economy to build on current strengths to develop and advance centers of innovation and high value production. Together with the development of Aerotropolis and future expansions of DEN, Hyperloop will increase the region's export capabilities and capacities significantly.



### RESULTING "ARC OF INNOVATION"

#### Increases the Economic Competitiveness of the Front Range

- Enhances multimodal connections between the region's many universities, federal research labs, and industry clusters
- Removes distance as an inhibitor of seamless collaboration and integration for similar areas of economic/academic specialization that are geographically dispersed (such as renewable energy clusters in Greeley, Longmont/Boulder, and Pueblo)
- Continues to attract business through fast efficient intraregional transportation coupled with a diverse, resilient, and technology-driven economy
- Enables agglomerative benefits such as increased productivity, closer (B2B and B2G) relationships, and supply chain integration

#### Enhances the Front Range's Ability to Attract and Retain Talented Workforce

- Coupled with existing and future transit systems, the entire Front Range (including the mountainous recreational areas to the west) is a reasonable commuting distance (<1 hour) using Hyperloop
- The workforce can live where they want, enjoying lifestyle benefits that drew them to the Front Range, while working at any of the diverse economic centers around the region
- Attraction and retention of a talented workforce will contribute to ongoing multifaceted stimulus for business investment

#### Enables Growth of Technology-Driven Industry Clusters Reliant on Fast Domestic and Global Distribution

- Supports DEN as the main conduit for the movement of high value and time sensitive freight throughout the entire Rocky Mountain region
- Leverages competitive strengths in bioscience, health services, advanced manufacturing, and science-led agribusiness with proximal federal laboratories and universities—resulting industry clusters will be enabled by quick transportation to DEN for air freight to domestic and international destinations
- Enables the advent of an industry cluster for 3-D printing of organs and prosthetics, vaccine manufacture, and personalized pharmaceuticals
- Increases the value of the beef industry to produce high quality, never frozen marbled beef for export to lucrative Asian markets

#### Leads to a Higher Level of Gross Regional Economic Output

- Increases levels of business attraction, value-adding to areas of economic specialization, consolidation of supply chain, and gradual increase in productivity equate to higher levels of economic output than if Hyperloop were not developed
- Hyperloop's introduction and operation will augment the Front Range's GRP by an estimated \$25 billion per annum, or about 7 percent by 2040

The Rocky Mountain Hyperloop will act as a catalyst for a multifaceted transformation throughout the Front Range, facilitating change to the existing economic, socio-demographic, and environmental paradigms of the region. It will change the way that people move throughout the region, allowing the Front Range's workforce to live where they want while easily accessing its many specialized, knowledge-driven clusters of economic activity. It will change the way that freight moves through the region, increasing the region's import/export capability while contributing to a significant reduction in road freight on the region's already congested network of interstate highways and state roads. It will enhance the region's economic competitiveness through agglomeration by enhancing accessibility and connectivity between its industry clusters, knowledge infrastructure, and the workforce.

**This transformational change that Hyperloop will enable in the region can be broken into three main elements:**

- 1. Change to future population and employment distribution and future land use across the region**
- 2. Creation of an alternative transportation corridor**
- 3. Enhancement of the regional economy and the creation of an "Arc of Innovation" through the seamless connection of its specialized industry clusters, knowledge infrastructure, and workforce.**

## POPULATION DISTRIBUTION AND LAND USE

The Front Range is growing at a faster pace than nearly every other metropolitan area in the country. Forecasts from the Colorado State Demography Office estimate

The Rocky Mountain Hyperloop will transform the region by:

- Enabling DEN as the focus and main conduit for the movement of high value and time sensitive freight throughout the entire Rocky Mountain region of the CanAm corridor stretching from Mexico to Canada
- Creating an alternative transportation corridor, providing more sustainable and cost effective options to manage the region's rapid population and economic growth
- Increasing the region's economic competitiveness by enhancing the multimodal connections between the region's many universities, federal research labs, industry clusters and its highly skilled—and with Hyperloop, incredibly mobile workforce
- Adding an additional 7 percent per annum to the regional real GRP by 2040

that the region will add an additional 2 million residents by 2040, an increase of nearly 45 percent from its current population. There is strong sentiment in the Front Range, at both a government and community level, to curtail future development along the western aspects of the region—the Rocky Mountains—so as to preserve these areas for recreation. In this sense, the Front Range urban and suburban boundaries will be extended east and north, with the strongest population growth occurring in Weld, Larimer, and Adams counties.

The Rocky Mountain Hyperloop will make nearly anywhere within the region a reasonable commutable distance, thus allowing the region's high value industries and specialized clusters to draw from a labor pool of millions, not hundreds of thousands.

The Rocky Mountain Hyperloop would support this forecast shift in the distribution of population across the region. In adding Hyperloop to the network of existing transportation and transit options, nearly anywhere in the Front Range will be within reasonable commuting distance (<1 hour). Aside from the implications of this enhanced accessibility on business to business (and business to government) relationships, physical proximity to employment centers will no longer be a determinant in deciding where to live. The highly skilled workforce will live where they want and enjoy the abundant lifestyle benefits that drew them to the Front Range in the first place.

Hyperloop will also influence future land use patterns in the region in regard to the densification of industrial and commercial land uses at key nodes along the proposed Hyperloop alignment. Hyperloop will be a major enabler and accelerant for the realization of the Aerotropolis around DEN, the hub of the proposed alignment. A more vertical integration of entities within the supply chain of advanced industries will choose to locate along the alignment due to increased accessibility to customers/suppliers and the region's workforce, as well as the ability to more efficiently import and export their inputs and finished products, respectively.

## CREATION OF AN ALTERNATIVE TRANSPORTATION CORRIDOR

The Rocky Mountain Hyperloop and the alternative transportation corridor that it will create will allow the state and region, already fiscally constrained, to entertain more manageable alternatives and strategies for addressing future infrastructure needs to support the region's more spatially dispersed population.

The Rocky Mountain Hyperloop will allow the transformation of the Front Range's economy into a seamlessly connected metropolitan region comprising high value clusters of technology driven industries supported by innovative and symbiotic knowledge infrastructure which attracts and retains a highly talented and competitive workforce.

The addition of nearly half to the existing population will put significant strain on the government to supply adequate infrastructure to meet the region's transportation needs. The existing interstate systems in the region are already heavily congested and this will be exacerbated by continued trends of heightened inward migration and economic growth.

We envision the north-south alignment running in an arc to the east of the existing interstate system, with DEN as the hub; its northern alignment stretching beyond Fort Collins to I-80 in Wyoming, and the southern alignment extending to Pueblo. This will create an alternative transportation corridor for passengers and freight that circumvents the most densely populated and congested areas of the Front Range, including downtown Denver. Intermodal freight destined for export or domestic movement via air freight, or for distribution centers located around the periphery of Denver, will no longer need to access the central parts of the region; rather, this freight can be transferred to/from Hyperloop sleds at intermodal facilities in the northern and southern aspects of the alignment, thereby alleviating congestion and removing road freight traffic from the heavily populated urban areas. This will also deliver significant environmental benefits (lower emissions) as well as significant operating cost reductions (reduced maintenance costs and prolonged asset life) to the state.

This alternative transportation corridor will also enhance the region's strategic military importance, particularly in regard to the movement and quick response of key military personnel and equipment should the need arise. It will provide greater accessibility to the abundant recreational areas and their vibrant tourism economies to the west of Denver, further bolstering the lifestyle benefits that draw and retain the Front Range's residents.

Over time, the Rocky Mountain Hyperloop, with DEN as its focal center and cargo hub, will become the main conduit for the movement of high value and time sensitive freight throughout the entire Rocky Mountain region. It will do so in a manner that is more efficient, cost-effective and sustainable than current modes of freight transportation, and in doing so, will generate profound environmental and economic benefits

associated with reduced emissions, avoidance of road accidents, and travel time and operator costs savings. Hyperloop will increase the region's export capabilities and capacities significantly.

## ARC OF INNOVATION

The diversified and knowledge driven economy of the Front Range will benefit greatly from the accessibility and connectivity that Hyperloop will add. The region's economy is already a powerhouse, holding competitive advantages across several industries including health and bioscience, education, aerospace, advanced manufacturing, renewable energy, and information technology. The region is home to one of the largest concentrations of federally funded science and research centers in the nation, with more than 30 facilities including the Center for Disease Control (CDC), NREL, and several facilities related to atmospheric sciences and their application to aerospace. The Front Range is of significant strategic importance to the US military, with the region housing five US Air Force facilities, as well as the North American Aerospace Defense Command (NORAD).

Hyperloop will supplement these competitive economic attributes and assets by enhancing the multimodal connections between the region's many universities, federal research labs, industry clusters and its highly skilled—and with Hyperloop, incredibly mobile—workforce. Combined with the Front Range's existing and future transit network, Hyperloop will make the entire Front Range commutable, thus allowing its many advanced industries and specialized clusters to draw from a workforce of millions as opposed to hundreds of thousands. It will connect key centers of specialization that are currently dispersed across the region (e.g., aerospace research and development and component manufacturing are clustered around both Fort Collins and Colorado Springs) and reduce the travel time between these centers from hours to minutes. The accessibility that Hyperloop will provide to industry in regard to the ability to export high value, time sensitive cargo will support the augmentation of existing industry clusters and generate new specialized centers that leverage existing competitive advantages and strategic assets such as the regional workforce, knowledge centers, and advanced manufacturing capabilities.

The northern portion of the Front Range is well known for its competitive strengths in bioscience, health services, and medical component manufacturing, all of which are supported by, and collaborate heavily with, nearby universities and federally funded research centers. With the addition of Hyperloop, this center of specialization could foster an industry cluster that 3-D

prints organs and prosthetics (including those for hip and knee replacements). Establishing a center for 3-D printing, these high value medical products requires several criteria to be met: a nearby and secure power source, a technical and academic knowledge bank, advance manufacturing capabilities with specialization in precision molding and composites, and a strong bioscience private sector. All of these criteria are currently met in the northern Front Range, and Hyperloop facilitates meeting the final criteria—the ability to move these manufactured products quickly to domestic and foreign markets.

A second specialized industry cluster leveraging existing competitive strengths in bioscience and manufacturing would be for the research, production, and export of vaccines, anchored by the CDC facility in Fort Collins.

A less technology driven, but still high value industry, that would benefit from Hyperloop would be the beef production industry. Weld County contains some of the largest cattle feedlots in the US and beef is one of the state’s major export commodities to Canada and Mexico. However, only a fraction of the beef produced is of export quality for the significantly more lucrative Asian markets, which require meat that is more marbled, is never frozen, and is generally shipped by

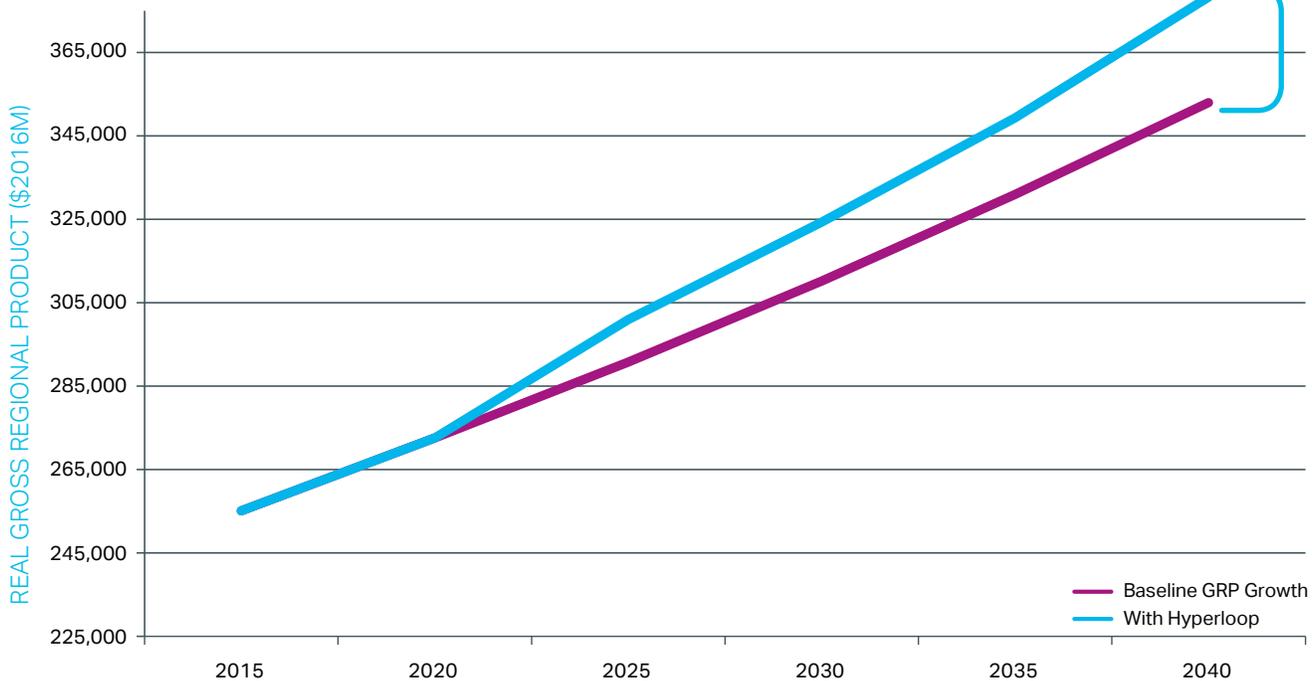
air. This industry could upskill to produce a higher value product, which would then use Hyperloop to quickly move export quality beef to DEN for direct air freight to Asian markets.

**LEADS TO HIGHER LEVEL OF GROSS REGIONAL ECONOMIC OUTPUT**

The catalyst that Hyperloop generates for business attraction and growth will gradually lead to higher levels of real GRP across the Front Range. Assuming commencement of operations of Accelerated Phase 1 of the Rocky Mountain Hyperloop in 2020 and full operation of the network by 2040, the development and operation of Hyperloop will contribute to an additional \$25 billion per annum to the Front Range’s real GRP by 2040, or an additional 7 percent, nearly as much as DEN’s current contribution to the regional economy.

**~\$25 billion**  
 Estimated annual additional GRP attributable to Hyperloop in 2040

**REAL GROSS REGIONAL PRODUCT, FRONT RANGE REGION (2015-2040)**



Source: BLS, University of Colorado, AECOM

1. Including, but not limited to: National Ocean and Atmospheric Administration (NOAA), Cooperative Institute for Research in the Atmosphere(CIRA), National Center for Atmospheric Research (NCAR), University Corporation for Atmospheric Research (UCAR)  
 2. Estimates in \$2015. Assumes real GDP growth of 1.31% vs. 1.51% per annum from 2015-2050 for the baseline and with-Hyperloop scenarios, respectively.

# 4

## Rocky Mountain Hyperloop Passenger and Cargo Flows



## Current and Projected **Population and Employment**

Population in the Front Range region is expected to grow by 45 percent from 4.7 million to 6.8 million by 2040. Employment is expected to grow by 46 percent. Recent population and employment projections within easy access (5 to 10 miles) of the proposed Hyperloop stations are summarized below. The proposed system connects high growth areas in satellite cities with the established resources and global reach of the Denver metropolitan area.

STATION AREAS	RESIDENTS					EMPLOYMENT				
	2015	2040	% CHANGE	HYPERLOOP	% CHANGE	2015	2040	% CHANGE	HYPERLOOP	% CHANGE
Cheyenne, WY	97,200	118,600	22%	118,600	–	50,300	72,400	44%	73,500	1.5%
Fort Collins	325,300	495,600	52%	536,400	8.2%	176,900	260,300	47%	281,700	8.2%
Greeley	100,300	212,000	111%	228,700	7.9%	51,100	77,200	51%	87,400	13.2%
Longmont/Boulder	436,700	647,000	48%	665,300	2.8%	237,000	360,700	52%	383,800	6.4%
I-76	145,200	269,500	86%	284,400	5.5%	73,400	108,400	48%	118,300	9.1%
DEN Aerotropolis	312,800	480,500	54%	490,500	2.1%	160,400	231,200	44%	240,700	4.1%
City of Denver	1,096,400	1,525,900	39%	1,540,900	1.0%	590,000	855,000	45%	877,000	2.6%
Southeast Denver	632,900	946,700	50%	970,700	2.5%	338,500	487,900	44%	510,500	4.6%
West Metro	565,100	686,300	21%	716,300	4.4%	311,700	449,200	44%	476,000	6.0%
Colorado Springs	674,600	964,300	43%	1,054,800	9.4%	300,700	444,800	48%	469,200	5.5%
Pueblo	162,800	206,500	27%	220,500	6.8%	69,100	99,600	44%	106,100	6.5%
Silverthorne/Dillon	14,900	24,900	67%	24,900	–	9,200	12,600	37%	12,800	1.6%
Vail	42,600	75,300	77%	75,300	–	26,400	38,100	44%	38,600	1.3%
<b>FRONT RANGE REGION</b>	<b>4,696,300</b>	<b>6,793,200</b>	<b>45%</b>	<b>7,070,400</b>	<b>4.1%</b>	<b>2,445,000</b>	<b>3,569,200</b>	<b>46%</b>	<b>3,750,500</b>	<b>5.1%</b>

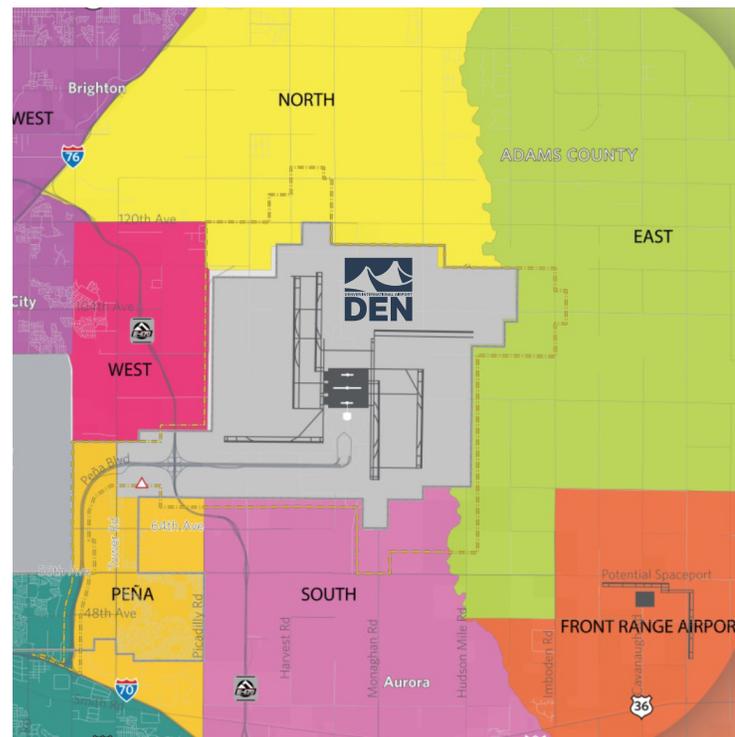
**Our initial estimates suggest that Hyperloop is likely to add 277,200 residents and 181,300 jobs to the Front Range region.** Most of this growth would be focused around the Hyperloop stations to take full advantage of the mobility and logistical benefits offered by a Hyperloop system. Hyperloop would transform the Front Range into a 200-mile-long mega-region and economic powerhouse with easy access to some of the most breathtaking natural resources in the world.

## Planned Hubs **DEN Aerotropolis and Airport City**

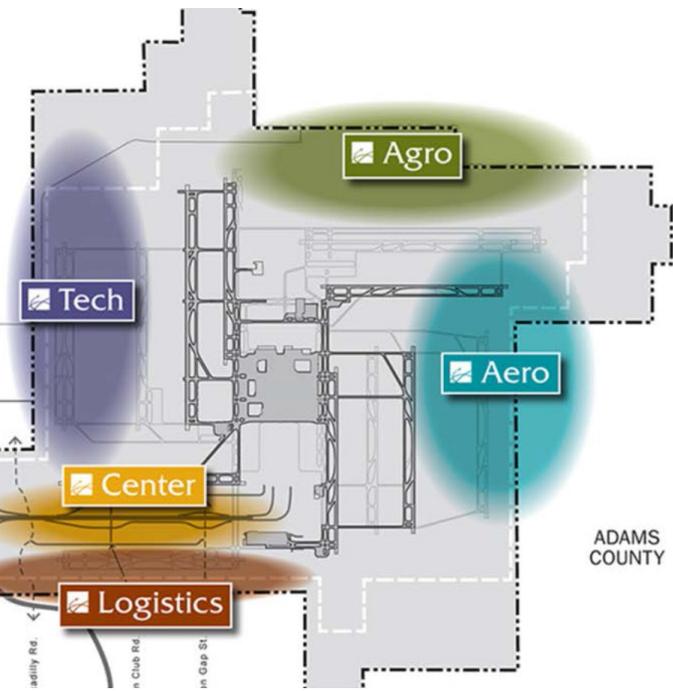
Although DEN has been one of the busiest airports in the world for years (ranked 19th by passenger volume and 6th in aircraft movements), Denver is just emerging in the global consciousness. As the region develops ever increasing global connections through commerce and tourism, DEN has unparalleled potential to serve the airlines and their international clients—business and leisure—who will be discovering the area.

With more than 54 million passengers traveling through the airport each year, DEN is the primary economic engine for Colorado, generating more than \$26 billion for the state, annually. This year, passenger traffic is 7.6 percent higher than in 2015 and international passenger traffic increased by 13 percent. Mail, freight, and express cargo operations generated 540 million pounds of cargo in 2015.

The DEN Aerotropolis vision capitalizes on the economic opportunity surrounding DEN through collaborative planning and development. There are still thousands of acres of undeveloped land surrounding DEN, which represents one of the greatest economic opportunities in the US and the world.



Expansive development opportunities near DEN.



### AIRPORT CITY MASTER PLAN

The development plans within the airport property dedicate the following five areas to key airport industries:

- **Agro:** 2,992 acres for industrial agriculture and perishable foods processing
- **Aero:** 1,966 acres of aviation and aerospace manufacturing, military, and free trade cargo and logistics
- **Tech:** 1,738 acres for bioscience and renewable energy
- **Logistics:** 259 acres for cargo distribution and operations
- **Center:** 1,257 acres for hotels, office parks, and air services

Tightly integrating Hyperloop into the air passenger and cargo functions of the airport will provide efficient connections to the existing transportation access and distribution facilities of the Denver metropolitan area. Hyperloop could seamlessly connect air passengers and cargo from airplanes to each destination within the Front Range system. With a direct connection to airport operations, Hyperloop could effectively serve as a network of satellite terminals enabling remote parking, ticketing, baggage check-in, and cargo processing functions. This could have huge benefits at DEN by reducing roadway congestion, reducing the space dedicated for parking and warehousing, and reducing the queues waiting for security checks.

## Current and Projected *Travel Time and Cost*

The table below shows estimates of current and predicted auto travel times and round trip costs between the proposed Hyperloop station areas and the DEN Aerotropolis. The table also shows the Hyperloop distance and travel time between the DEN Aerotropolis and each of the Hyperloop stations.

High frequency, high speed travel also makes it convenient for employees to consider using Hyperloop as their primary mode of travel to work. The traffic congestion, tolls, and transit options within the Denver metropolitan area would no longer be the constraining factor in people’s decisions about where to live and work. The Hyperloop option would make it faster to

commute from Colorado Springs or Fort Collins to the DEN Aerotropolis than it would take 80 percent of the residents of the Denver metropolitan area to reach the airport using existing modes. The stations on the west and south sides of Denver would totally transform the local travel patterns and build huge synergies of residential and commercial developments that mutually feed on the opportunities this technology supports.

Using Hyperloop offers an average travel time savings of more than **50 percent**, in some cases **75 percent**, when compared to travel times using current modes of travel. ▼

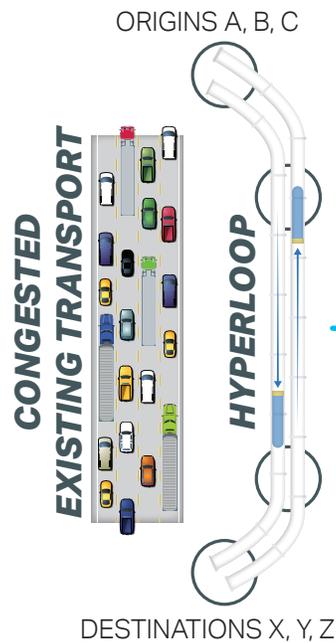
### AVERAGE TRAVEL TO DEN AEROTROPOLIS

STATION AREAS	AUTO TIME (MINS)		AUTO COST (2015 \$)		HYPERLOOP		TRAVEL TIME SAVINGS*	
	2015	2040	2015	2040	MILES	MINUTES	2015	2040
Cheyenne, WY	131	161	150	167	90	10.8	69%	75%
Fort Collins	107	133	111	123	70	8.4	64%	71%
Greeley	78	91	83	91	40	5.1	55%	61%
Longmont/Boulder	70	78	82	88	40	5.1	50%	55%
I-76	47	54	54	58	10	1.9	31%	41%
Denver Tech Center	53	59	63	69	35	5.6	32%	40%
West Denver	52	59	56	60	65	10.4	23%	31%
Colorado Springs	122	147	128	142	76	9.1	68%	73%
Pueblo	144	173	173	192	116	13.9	69%	75%
Silverthorne/Dillon	112	123	129	140	116	13.9	61%	64%
Vail	160	176	123	133	140	14.9	72%	74%
<b>AVERAGE TRAVEL TIME SAVINGS</b>							<b>54%</b>	<b>60%</b>

\*Assumes a standard 30 minutes for access/egress to origin/destination stations

The challenge would then become local access to the Hyperloop stations. Access issues can be minimized if the development density around the Hyperloop station is high and efficiently integrated. Since this proposal locates stations in sparsely developed areas, it is possible to encourage high density mixed use developments as part of the transformational nature of the project. Autonomous vehicles could also provide an efficient distribution system for sites within a few miles of the stations. To efficiently access existing land-uses further

from the station, good connections to freeways, transit routes, and rail yards will provide the necessary access and distribution facilities for both people and freight. For example, the DEN, DTC, and West Metro stations are intentionally located near the end of RTD transit A lines, radial freeways and circumferential toll roads to maximize coverage of the Denver region. Most of the satellite stations include convenient access to freeways, railroad yards, and regional airports to effectively serve passenger and cargo transfers.



Hyperloop's extremely efficient travel times between various origins-destinations, offer completely new opportunities for intercity and regional travel for both passengers and cargo. By effectively linking Hyperloop stations with local transportation systems, whole new areas of economic development and regional interconnectivity can flourish. For example,

- The two-hour drive from Colorado Springs to DEN could be replaced with a 40-minute linked trip comprising less than 10 minutes on Hyperloop and a total of 30 minutes using other connecting services such as bus transit or Rideshare Service.
- Aerospace collaboration between Colorado State University in Fort Collins and the Air Force facilities in Colorado Springs could be greatly enhanced by replacing the four-hour truck trip with efficient cargo exchange facilities for the 17-minute Hyperloop trip.

## Current and Projected **Passenger and Cargo Demand**

Colorado has been studying the feasibility of high-speed passenger and freight alternatives for some time. The High-Speed Rail Feasibility Study of March 2010 examined high-speed transit (HST) along the Front Range from Cheyenne, Wyoming to Trinidad, Colorado. This study concluded that HST is feasible within FRA guidelines in the Front Range corridor from Fort Collins to Pueblo and on the I-70 mountain corridor from DEN to the Eagle County Regional Airport. The Interregional Connectivity Study of 2012 estimated a demand in 2035 of 13.8 million riders per year with annual revenue of \$249 million. The Advanced Guideway System Feasibility Study of 2014 estimated that high-speed transit between Golden and Breckenridge, Vail, and Avon ski resorts would cut the drive time in half and attract 6.2 million riders per year.

The Colorado Freight and Passenger Rail Plan of 2012 was designed to expand the rail infrastructure and service to provide increased transportation capacity, cost-effectiveness, accessibility and intermodal connectivity to meet freight and passenger market demands through investments that include P3s. Nearly one-fourth of all freight handled in Colorado is moved via rail. The commodities carried totaled nearly 2.4 million carloads, with a combined value of \$107 billion. The vast majority of the rail traffic is

coal from Wyoming destined for Texas and states east of Colorado. The intrastate rail market that could be served by Hyperloop includes 9.3 million tons or 84,813 loads per year at a value of \$700 million.

The North I-25 Environmental Impact Study in 2011 analyzed multi-modal alternatives for addressing regional and inter-regional movement of people, goods and services on the I-25 corridor from Fort Collins to Denver. Under the preferred alternative, I-25 would be widened with general purpose lanes and toll express lanes. It would include commuter rail transit service from Fort Collins to Denver and express bus service on toll lanes connecting northern Colorado communities to downtown Denver and DEN. Commuter bus service along US 85 would connect Greeley with downtown Denver. By 2035, the preferred alternative would reduce travel times in general purpose lanes by 26 minutes and in toll express lanes by 52 minutes. Commuter rail would be 40 minutes faster than driving and reduce arterial volumes 5,000 to 25,000 vehicles per day. Widened I-25 would serve 990,000 daily person trips. Commuter rail, BRT, and express bus ridership would attract about 6,500 riders per day.

## Current and Projected **Regional Intercity Trips**

In each of these cases, the Hyperloop alternative would be four times faster than any of the high speed transit alternatives previously considered and 12 times faster than the commuter rail and express bus options. These levels of travel time savings could dramatically shift the mode choice from driving to Hyperloop and significantly reshape travel patterns and transportation investments in the region. The current number of automobile trips over 50 miles within the Front Range region include 120 million non-work trips, 14 million work trips, and 23 million visitor trips per year. These trips are expected to grow to 143 million non-work trips, 17 million work trips, and 28 million visitor trips by 2040. There are currently 330,000 intercity transit trips per year that are expected to grow to 440,000 by 2040. There are currently 630,000 air transfer trips between DEN and Colorado Springs each year and 103,000 air transfer trips between DEN and Eagle County Regional Airport. These are the types of trips that are well suited for Hyperloop alternatives and could easily grow by an order of magnitude given Hyperloop travel times.

Tourism is the second largest industry in Colorado, generating \$750 million in local and state tax revenue in 2010. Colorado continues to lead all states in the competitive overnight ski travel market, garnering approximately 19 percent of all trips in 2011. By year 2035, I-70 west of Denver will operate over capacity all day on Saturdays, Sundays, holidays, and some weekday periods. Long travel times deter travel and negatively affect mountain community economies as would-be visitors choose not to travel due to poor travel conditions.

**Hyperloop travel times could significantly increase these travel markets and make Hyperloop the preferred mode of travel for both passenger and cargo trips.**

The tables below show current estimates of auto and truck trips between the proposed Hyperloop station areas and the DEN Aerotropolis and the Denver metropolitan area destinations. These two destinations alone attract more than 1 million trips per day from areas served by Hyperloop stations. ▼

### ANNUAL TRIPS TO DEN AEROTROPOLIS (1000s)

STATION AREAS	WORK TRIPS			NON-WORK TRIPS			TRUCK TRIPS		
	2015	2040	% CHANGE	2015	2040	% CHANGE	2015	2040	% CHANGE
Cheyenne, Wy	0	0	0%	63	131	108%	88	183	108%
Fort Collins	59	172	192%	634	1,314	107%	705	1,460	107%
Greeley	200	418	109%	559	898	61%	798	1,283	61%
Longmont/Boulder	1,684	3,205	90%	3,967	5,872	48%	1,013	1,327	31%
I-76	2,468	6,348	157%	9,757	14,648	50%	1,547	2,226	44%
DEN Aerotropolis	10,305	17,712	72%	23,219	37,608	62%	6,466	8,643	34%
Denver Tech Center	5,162	7,787	51%	9,013	12,747	41%	2,734	3,366	23%
West Metro	1,311	1,736	32%	2,573	3,101	21%	629	743	18%
Colorado Springs	15	36	140%	869	1,563	80%	887	1,595	80%
Pueblo	0	0	0%	43	78	81%	80	144	80%
Silverthorne/Dillon	0	0	100%	3,520	5,144	46%	555	789	42%
Vail	0	0	100%	3,600	5,743	60%	707	948	34%
<b>FRONT RANGE REGION</b>	<b>26,769</b>	<b>50,413</b>	<b>88%</b>	<b>81,185</b>	<b>120,801</b>	<b>49%</b>	<b>23,331</b>	<b>32,541</b>	<b>39%</b>

### ANNUAL TRIPS TO DENVER METRO (1000s)

STATION AREAS	WORK TRIPS			NON-WORK TRIPS			TRUCK TRIPS		
	2015	2040	% CHANGE	2015	2040	% CHANGE	2015	2040	% CHANGE
Cheyenne, Wy	0	0	0%	159	329	107%	220	456	107%
Fort Collins	147	430	193%	1,586	3,286	107%	1,762	3,651	107%
Greeley	184	386	110%	516	829	61%	737	1,185	61%
Longmont/Boulder	9,037	11,252	25%	4,893	5,902	21%	4,362	5,385	23%
I-76	5,150	7,573	47%	7,013	8,947	28%	1,551	2,067	33%
DEN Aerotropolis	12,818	20,257	58%	28,066	36,391	30%	6,642	9,057	36%
Denver Tech Center	26,936	33,830	26%	28,435	34,141	20%	14,550	18,762	29%
West Metro	24,751	30,937	25%	42,181	47,955	14%	11,893	13,596	14%
Colorado Springs	131	320	144%	7,716	13,875	80%	7,873	14,159	80%
Pueblo	0	0	0%	638	1,148	80%	1,185	2,132	80%
Silverthorne/Dillon	0	0	100%	927	1,279	38%	215	276	28%
Vail	0	0	100%	619	1,783	188%	206	594	188%
<b>FRONT RANGE REGION</b>	<b>204,752</b>	<b>287,816</b>	<b>41%</b>	<b>517,365</b>	<b>684,883</b>	<b>32%</b>	<b>149,141</b>	<b>192,200</b>	<b>29%</b>

# 5

## Government and Policy



## Existing Colorado Investment Structure for *Infrastructure*

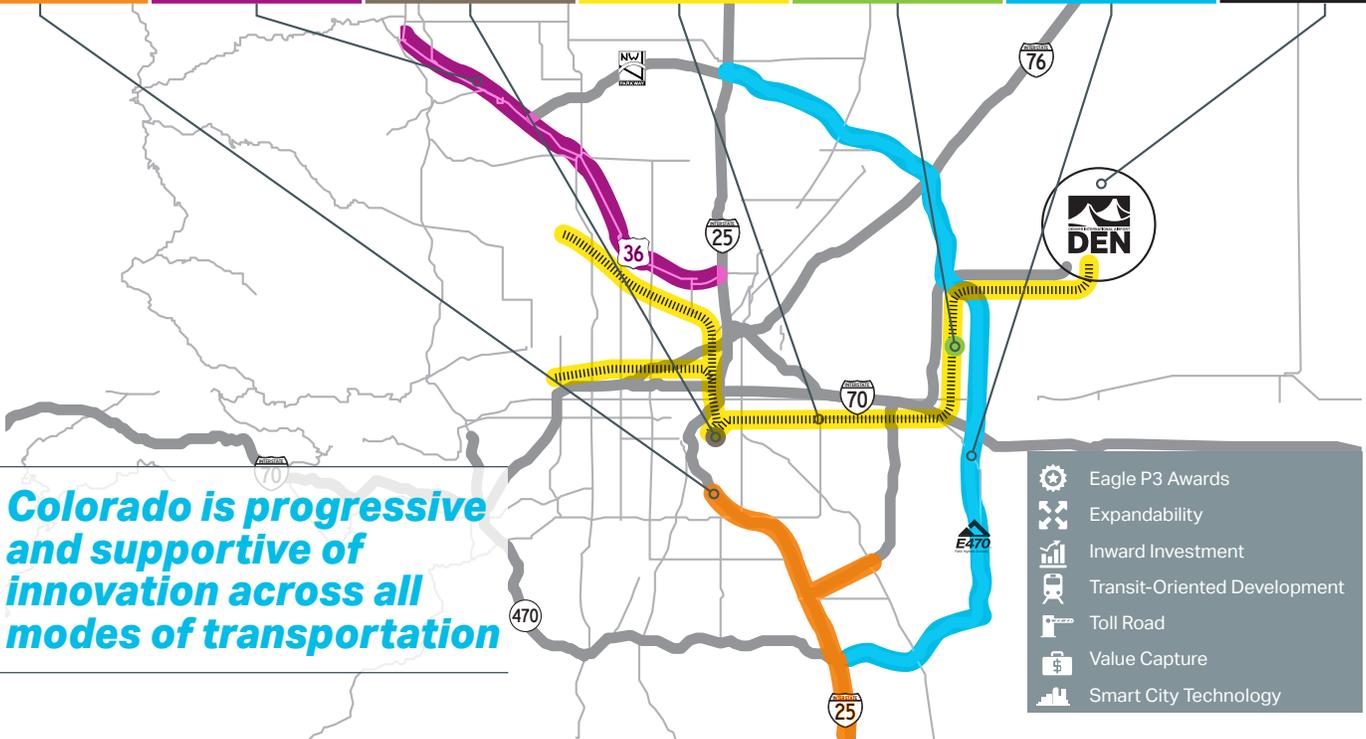
Colorado has historically used innovative project delivery methods across all modes of transportation infrastructure. This is mainly due to a conducive legislative environment and broad citizen support.

The majority of capital projects are completed 100 percent by the state with state funds or a combination of state and federal funds, and operated 100 percent with state and federal funds. However, Colorado has used a variety of other funding models to implement and maintain transportation improvements, including P3s. Colorado has completed P3s with a mixture of public finance with private equity for capital expenditures and then allocated toll risk and maintenance responsibility to the private partner, as well as P3s with full DBFOM contracting through an availability payment model.

CDOT's High-Performance Transportation Enterprise (HPTE) was formed to aggressively pursue innovative means of more efficiently financing important surface transportation infrastructure projects that will improve the safety, capacity, and accessibility of the surface transportation system; feasibly be commenced in a reasonable amount of time; allow more efficient movement of people, goods, and information throughout the state; and accelerate the economy of the state. Such innovative means of financing projects include, but are not limited to; P3s, operating concession agreements, user fee-based project financing, and availability payment and design-build contracting.

## Colorado Infrastructure *Project Examples*

TREX	US 36 P3	UNION STATION	EAGLE P3	PEÑA STATION	E-470	DENVER (DEN)
<b>Dates:</b> 2001 -2006 <b>Cost:</b> \$1.67 billion <b>Length:</b> 20 miles <b>Markets Served:</b> Highway, Transit <b>Delivery Method:</b> Design-Build	<b>Dates:</b> 2012 -2016 <b>Cost:</b> \$500 million <b>Length:</b> 18 miles <b>Markets Served:</b> Highway, Transit <b>Delivery Method:</b> P3	<b>Dates:</b> 2012 -2014 <b>Cost:</b> \$375 million <b>Markets Served:</b> Transit <b>Delivery Method:</b> Design-Build	<b>Dates:</b> 2011 -2016 <b>Cost:</b> \$2.2 billion <b>Length:</b> 36.0 miles <b>Markets Served:</b> Transit <b>Delivery Method:</b> P3	<b>Dates:</b> Ongoing <b>Cost:</b> Unknown <b>Markets Served:</b> Residential, Business <b>Delivery Method:</b> Design-Build	<b>Dates:</b> 1991 - 2003 <b>Cost:</b> \$1.23 billion <b>Length:</b> 47.0 miles <b>Markets Served:</b> Denver Region <b>Delivery Method:</b> Design-Build, CM/GC	<b>Dates:</b> 1989 - 1995 <b>Cost:</b> \$4.8 billion <b>Markets Served:</b> Aviation, Commercial <b>Delivery Method:</b> Various



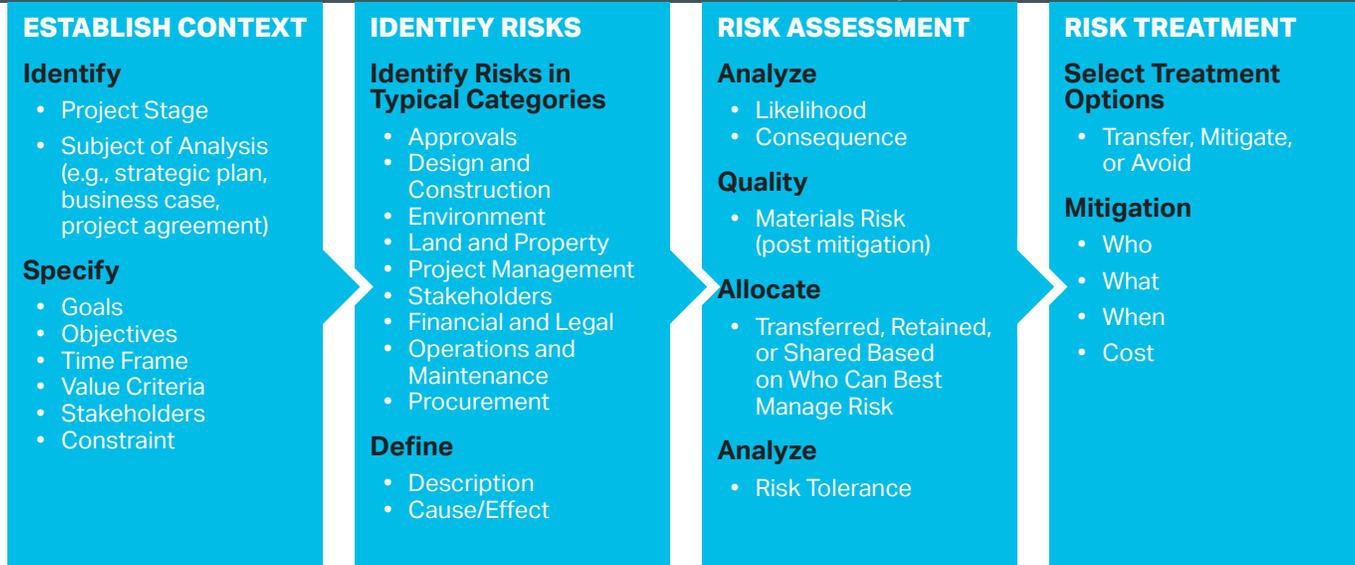
**Colorado is progressive and supportive of innovation across all modes of transportation**

## Risk Mitigations in Colorado for *Private Sector Investors*

As an example, CDOT’s HPTE uses a risk process to determine which risks they retain, transfer to developer, or share. Rights-of-way acquisition, utilities, hazardous materials, political, and environmental (NEPA) risks are usually kept by CDOT/HPTE. CDOT/HPTE uses a risk management process to evaluate various risks and determine the appropriate responsibilities and mitigations. The risk mitigation process is outlined in the graphic below.

### Key Focus Area: Communication with Stakeholders

*Determine Roles and Responsibilities for Risk Management*



### Key Focus Area: Monitor and Review

*Actively Update as New Information Becomes Available*

## Supportive Programs that Affect *Transportation, Energy, and Environmental Policy*

#### CMAQ

Congestion Mitigation and Air Quality (CMAQ) is a federal program that provides states with a grant to address pollution. Administered by Federal Highway Administration (FHWA), the CMAQ program has been reauthorized under every successive transportation bill up to and including the FAST Act in 2015.

**BENEFIT TO HYPERLOOP:**

- Rocky Mountain Hyperloop may obtain grant funding from CMAQ through a competitive selection process.

#### RoadX

RoadX is Colorado’s bold commitment to be a national leader in using innovative technology to improve the state’s transportation system. Its mission is to partner with public and industry partners to make Colorado one of the most technologically advanced transportation systems in the nation, and a leader in safety and reliability.

**BENEFIT TO HYPERLOOP:**

- CDOT’s RoadX will be a valuable advocate for Hyperloop development.

#### Executive Order 2015-013

Colorado’s Governor signed an Executive Order establishing one and five year goals in the areas of energy and water efficiency, petroleum reduction, greenhouse gas emissions reduction, and environmental preferable purchasing.

**BENEFIT TO HYPERLOOP:**

Colorado’s government values sustainable transportation technology.

#### Colorado Energy Office

The Colorado Energy Office (CEO) has the mission to improve the effective use of all of Colorado’s energy resources and the efficient consumption of energy in all economic sectors by providing technical guidance, financial support, policy advocacy and public communications.

**BENEFIT TO HYPERLOOP:**

Various Colorado Energy Office programs will align with Hyperloop development.

## Value of *Time*

**Recreational Trip (DEN to Vail):** Rental Car (\$80), Value of Time Spent Driving/Riding in Car per Adult (\$34 - \$85)

**Commercial Trip (DEN to Greeley):** Value of Time for Operating Truck (\$87 - \$174)

	TYPICAL CDOT*	STANDARD USDOT	% DIFFERENCE IN VALUE OF TIME
 <b>COMMUTER</b>	<b>\$17</b> an hour	<b>\$13.31</b> an hour	<b>+28%</b>
 <b>COMMERCIAL</b>	<b>\$87</b> an hour	<b>\$75.85</b> an hour	<b>+15%</b>

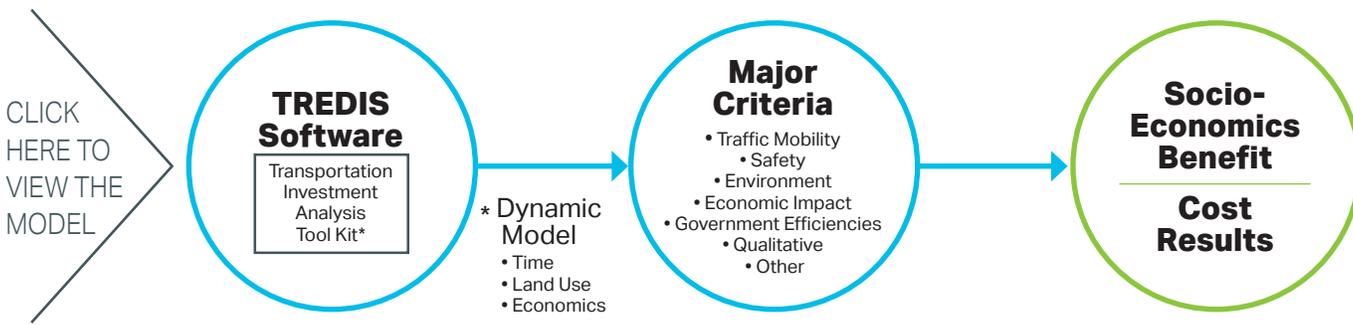
*\*CDOT calculates value of time for each specific project and primarily considers median income in the market served.*

Rocky Mountain Hyperloop will benefit from the higher value of time in Colorado.

## Colorado Transport *Appraisal Model*

TREDIS is an example tool that CDOT developed to estimate economic benefits and impacts of projects/ investments. The tool is capable of assessing the economic benefits in terms of direct monetary savings as a result of improvement in the performance indicators of transportation. It can also estimate the economic impact of the monetary savings when supported by Colorado economic data. The Transportation Investment Analysis Tool Kit would be

effective in capturing Hyperloop’s momentous impact on travel time, spatial geography, and macro-economic variables. This data is already included in the Tool Kit’s assessment of the projected benefits. The Tool Kit allows for the use of shifting land use assumptions; hence, it could capture the positive impacts of the relocation of employment or residents due to travel time reduction.



CAPTURING RADICAL IMPACTS ON TIME, SPATIAL GEOGRAPHY, AND MACRO-ECONOMICS

## Top 3 Socioeconomic *Benefits from Hyperloop*

**1 Enhanced Connectivity and Accessibility:** From a travel time perspective, nearly everywhere is commutable within the Front Range region, leading to greater workforce attraction and retention. Businesses are closer to their customers and can draw from a larger pool of talent. Business relationships are amplified due to “enhanced proximity” and greater supply chain integration. This leads to greater business attraction and gradual productivity gains, both of which lead to higher economic output.

**2 Lifestyle and Amenity Benefits:** Many move to, or stay in, the Front Range due to the lifestyle benefits that it offers. Hyperloop enables them to live where they want and work nearly anywhere within the Front Range. Proximity to recreational areas, preservation of said recreation areas (by pushing future development to the east) and more free time lead to improvements in public health and in the overall quality of life. Less traffic in established areas leads to better air/noise quality.

**3 Additional and More Sustainable Options for Regional Planning for the Future:** Creation of an alternative transportation corridor has environmental benefits (emissions reduction, state of good repair improvements), safety benefits (fewer accidents and fatalities) and efficiency benefits (less congestion, reduced travel times). It also allows for the government to develop and implement planning that avoids building additional highway capacity to accommodate increased traffic on an already overly congested road system. Opportunities exist for Smart, mixed-use, communities with good access to Hyperloop stations.

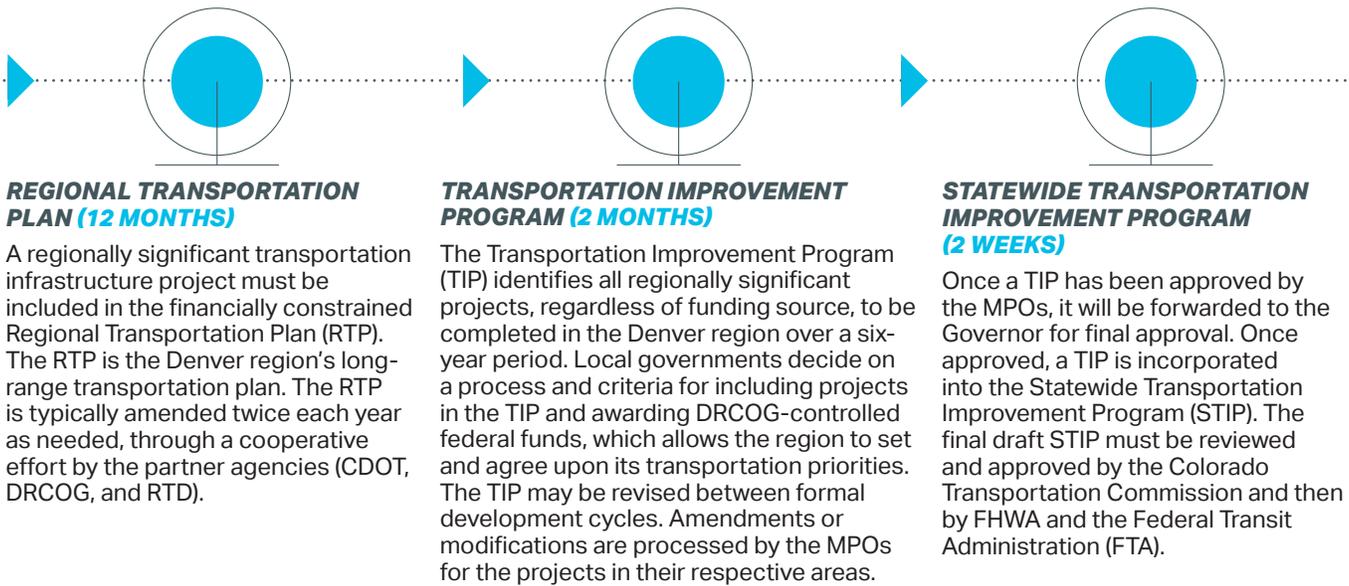
## Inward *Investment*

Programs to attract investors will focus on investment into the development of the Hyperloop infrastructure itself. The HPTE US 36 P3 project exemplifies this approach. Transportation Infrastructure Finance and Innovation Act (TIFIA) loans and a Transportation Investment Generating Economic Recovery (TIGER) grant secured by CDOT and the local municipalities made possible a partnership with a private sector concessionaire. The concessionaire also secured pension fund investment and brought their own private equity for US 36.

### COLORADO EXAMPLE OF ATTRACTING MULTIPLE FUNDING/FINANCE SOURCES US 36 P3 FUNDING/FINANCE

- TIFIA Loan
- TIGER Grant
- Toll Revenue
- Private Equity and Institutional Funds

TYPICAL PROJECT DEVELOPMENT PROCESS



EXAMPLE AGENCIES INVOLVED IN PROJECT DEVELOPMENT

#### STATE/LOCAL AGENCIES

 <b>COLORADO</b> Department of Transportation <a href="http://www.codot.gov">www.codot.gov</a>	Denver Area Planning  DENVER REGIONAL COUNCIL OF GOVERNMENTS <a href="http://www.drcog.org">www.drcog.org</a>	Denver Area Public Transportation  <b>MUNICIPALITIES/ COUNTIES</b> <a href="http://www.rtd-denver.com">www.rtd-denver.com</a>
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#### STATE LEGISLATURE

<p><b>Private Lobby</b></p> <ul style="list-style-type: none"> <li>• Colorado Contractors Association</li> <li>• Colorado Motor Carriers Association</li> <li>• Southwest Energy Efficiency Project</li> <li>• Bicycle Colorado</li> <li>• The Transit Alliance</li> </ul>	<p><b>Legislative Council Staff</b> <b>Governor's Office</b></p> <p>Nonpartisan Research Arm of Colorado General Assembly</p> <p><a href="http://www.leg.colorado.gov">www.leg.colorado.gov</a></p>
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#### Regulatory bodies for current *Modes of Transportation*

<p><b>COLORADO</b></p> <p>CDOT Colorado Public Utilities Commission Colorado State Patrol</p>	<p><b>FEDERAL-US</b></p> <p>USDOT US Department of Homeland Security Environmental Protection Agency</p>	<p><b>RESEARCH BRANCHES</b></p> <p>Transportation Research Board National Cooperative Highway Research Program RoadX</p>
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# 6

## Acceleration Plan



## Leveraging Strengths to **Accelerate**

The introduction and operation of the Rocky Mountain Hyperloop will require close collaboration between the public and private sectors comprising a suite of P3s, all working towards the long-term outcome of developing, operating and maintaining the Hyperloop and integrating it into the fabric of the transportation system. To achieve this outcome, a clear path must be established to address regulatory requirements, funding and financing strategy and mechanisms (including investment attraction strategy), procurement processes, alignment of policies (transportation, land use, economic development), and governance. The streamlining of several of the above mentioned processes over the near-term will accelerate the development of the Hyperloop, leading to a faster accrual of benefit.

HYPERLOOP DEVELOPMENT ACTIVITIES	COLORADO PATHWAYS TO ACCELERATION
<b>PLANNING</b>	<ul style="list-style-type: none"> <li>• Use already tested procurement and project implementation processes for DBFOM P3 model in Colorado</li> <li>• Begin the process of identifying, assigning, and mitigating risk</li> </ul>
<b>RIGHTS-OF-WAY</b>	<ul style="list-style-type: none"> <li>• Leverage government experience with collective negotiation with multiple landowners</li> <li>• Propose alignment largely in areas with lower complexity of ownership and through undeveloped areas</li> <li>• Integrate region-wide transportation and land use planning to align Hyperloop activated employment centers and transit-oriented development (TOD) hubs</li> </ul>
<b>REGULATORY PROCESSES</b>	<ul style="list-style-type: none"> <li>• Use PELs and EA templates to accelerate regulatory review process and secure early stakeholder consensus</li> <li>• Perform EA of entire network alignment up front to potentially limit the need for future assessment at later stages of development</li> </ul>
<b>PROCUREMENT MODEL</b>	<ul style="list-style-type: none"> <li>• Promote transparency with all P3 parties as well as with stakeholders</li> <li>• Develop performance level specifications to ensure proposer flexibility while also holding all parties accountable</li> <li>• Implement alternative technical concepts (as opposed to value engineering)</li> </ul>
<b>FUNDING AND FINANCING</b>	<ul style="list-style-type: none"> <li>• Allocate risk commensurate to project partner’s roles</li> <li>• Use the “Three Legged Stool” of financing (jurisdictional, federal, and private); provide access to federal funding and financing vehicles</li> <li>• AAA credit rating from state government to allow investment by institutional and sovereign funds</li> <li>• Implement various value capture mechanisms at greenfield/brownfield sites along alignment</li> </ul>
<b>COMPLEMENTARY INVESTMENT ATTRACTION/ ECONOMIC DEVELOPMENT STRATEGY</b>	<ul style="list-style-type: none"> <li>• Provide incentives in mixed-use developments around stations and activity centers</li> <li>• Encourage local jurisdictions to develop investment incentives to attract investment and encourage supply chain integration</li> <li>• Establish Special Economic Zone near DEN for concentration of export focused industries</li> <li>• Develop state and local programs of incentives for innovation in complementary automated systems addressing freight</li> </ul>

**Public Sector** government, at a state and local level, will enable an accelerated acquisition of rights-of-way for the Hyperloop alignment, streamlining the regulatory process and the establishment and implementation of policy to integrate Hyperloop into the regional transportation network and to incentivize investment into key economic centers within, and connected to, the corridor. The Colorado State Government has earned a reputation for its innovative approach to accelerating major transportation infrastructure projects in regard to both financing and streamlining regulatory processes through its HPTE, RoadX, and other divisions of CDOT.

## STREAMLINED REGULATORY PROCESS

The Colorado State Government has earned a reputation for its nation-leading approach to accelerating major transportation infrastructure projects in regard to streamlining regulatory processes and implementing P3 models that emphasize transparency, shared risk, and innovative financing.

**Private Sector** entities will accelerate the development of Hyperloop by providing financing and leading the development of the infrastructure and mixed use precincts around stations and employment centers. Following infrastructure development, the private sector, through concessionaire agreements, will be responsible for the development, operation, and maintenance of the Hyperloop as well as for the operation of related intermodal freight facilities. Simply stated, the structuring of the various P3s will allow the spreading of risk across the various involved entities. The government will hold the underlying risk associated with the acquisition and ownership of the corridor rights-of-way as well as the associated environmental risk. The private sector will take on construction risk, patronage risk, and cargo risk. These more financially focused risks to be taken on by the private sector will be partially mitigated by the public sector involvement which will open the door for favorable federal funding and financing mechanism as well as providing a more attractive investment platform (through an AAA credit rating) for institutional investors.

## ACCELERATING THE RIGHTS-OF-WAY/ CORRIDOR ACQUISITION

The state government will play a central role throughout all aspects of the development of the Hyperloop network, but particularly in the first and most important step, the acquisition and preservation of the alignment corridor. The government can leverage its experience with collective negotiation with multiple landowners, including state and federal

agencies, to ensure the timely acquisition and preservation of parcels that make up the alignment. As a last resort, the state government may also exercise its power of eminent domain (also known as compulsory acquisition). Concurrent with land acquisition, the state government will liaise with local governments to make required changes in land use around the alignment, including in the areas designated for stations and surrounding developments. In taking on the responsibility and risk associated with the corridor acquisition, and land use, several years can be shaved off of the development process

## ACCELERATING THE REGULATORY PROCESS

A publicly owned corridor will trigger regulatory processes that potentially would not occur otherwise, such as the NEPA review process. Colorado has been a leader in accelerating and streamlining the NEPA process. PELs help identify preferred alternatives which identify and address future NEPA requirements and needs. Their use can potentially limit the need for future alternatives analysis, assess environmental impacts on the entire corridor (not just the first phase), and could limit the need to revisit these processes as later stages of the vision progress. Processes such as public outreach, development of partnerships, and documentation of alternatives all take place during the PEL process. The EA template standardizes and reduces the size of EA documents and improves readability for stakeholders, including agencies and the public. Shorter, more understandable documents generally mean shorter review times, which allow transportation projects to progress more quickly through the project development process.

There are also several attributes of the Rocky Mountain Hyperloop alignment that will contribute to an accelerated regulatory review process. The proposed alignment passes through largely rural regions, with proposed station precincts located in undeveloped areas within proximity of urban density. The nature of the design of Hyperloop would allow for the network to span over wildlife and wetland areas. Given that the proposed alignment will largely pass through agricultural lands and areas currently planned for industrial development, the environmental impacts, including environmental justice concerns are not anticipated to be complex.

## ACCELERATING THE PROCUREMENT PROCESS

In addition to being a national leader in streamlining and accelerating the regulatory appraisal processes for major transportation infrastructure projects, Colorado has also set the benchmark for innovative procurement strategies within the context of P3s. The procurement process for Hyperloop, comprising everything from construction of the infrastructure to appointment of a concessionaire to operate and maintain the network, will be undertaken within a framework that ensures transparency, cooperation, and shared risk among the various project partners. This procurement framework will accelerate the first phase of development and provide an adaptable and efficient model for the future development of the larger Rocky Mountain Hyperloop network. The key aspects of the procurement model are:

- The promotion of transparency throughout all stages of planning and development
- The maximization of proposer flexibility through the use of performance level specifications
- The implementation of alternative technical concepts (ATC) rather than a value engineering approach to enable proposers to effectively manage their anticipated project costs

CDOT and RTD have implemented several successful P3 models to deliver major transportation infrastructure. The procurement process which will accelerate the first phase of the Rocky Mountain Hyperloop (and which will be the framework used throughout the build out of the larger network) draws heavily from the model successfully implemented by RTD for the East and Gold Line P3 (Eagle P3). One of the largest P3s in the nation, the procurement model used for the Eagle P3 created a competitive environment which engaged the private sector in a way that resulted in \$300M savings below internal budget estimates.

The tenets of the overarching P3 structure—coupled with creative and diversified funding strategy rooted in the allocation of risk to the various project partners—will empower the P3 team while ensuring accountability, transparency, and efficient construction and operation.

## FUNDING AND FINANCING MECHANISMS

Rocky Mountain Hyperloop will provide ample opportunity for the application of various value capture mechanisms. The proposed stations and intermodal facilities will be located on the edge of existing regional centers with room for Smart growth. Value capture around stations will be used to offset the costs associated with the development of the

## VALUE CAPTURE POTENTIAL

Value capture mechanisms implemented around Hyperloop stations can be used to not only offset the front end costs of developing the infrastructure, but also to provide local jurisdictions with the funding to allow them to offer a suite of incentives for inward investment into employment centers within and around the stations.

Hyperloop infrastructure as well as to provide the state and local governments with funding to allow a suite of incentives to attract inward investment for employment centers. Future revenues to be collected under various value capture mechanisms will be used for payment of interest and capital of Hyperloop bonds, thereby lowering the financial commitment, and potentially underwriting risk, of private sector partners and investors.

The City and County of Denver (the owner and operator of DEN), has consistently been at the forefront of the implementation of innovative value capture strategies, particularly in regard to tax increment financing (TIF) of major infrastructure and urban renewal projects. TIF can be used in the development of the passenger station and cargo facilities at DEN, with jurisdictional tax for a specified area around the airport frozen at pre-development levels, and all future increases in jurisdictionally collected tax revenue for a specified period of time. For established areas along the alignment likely to benefit significantly from Hyperloop (for instance residential and employment parks within a five-mile radius of stations) a levy can be instituted in which a nominal increase in tax would be applied for a specified time period to be used to service interest and capital payments on federal loans.

Other value capture mechanisms can also be applied at greenfield sites near stations with the associated future tax revenues coupled with direct developer contributions to finance the development of required infrastructure (utilities, roads, parks, etc.) to service the station areas. To make these value capture mechanisms equitable for developers, and to promote sustainable mixed use transportation oriented development, the local and state government can offer development incentives such as bonus FAR (floor to area ratio), reduced parking requirements, reduced developer contributions, etc.

## A STRONG CREDIT RATING

Public sector involvement in the P3 will lend the project an AAA credit rating, opening the door for institutional investment. Furthermore, this allows for the project to access federal financing and funding vehicles, such as TIFIA loans and discretionary infrastructure grants, respectively.

As stated earlier, value capture can be one component used by the parties making up the P3 for funding and financing the Hyperloop network. While the private sector is more efficient in raising capital, the public sector involvement allows for access to lower rate borrowing programs and large scale grant funding. Most importantly, public sector involvement can lend the Hyperloop investment proposal its AAA credit rating which opens the door for a higher caliber of institutional investors such as sovereign wealth funds and pension funds, the traditional largest investor in listed and unlisted infrastructure assets. Federal financing vehicles such as TIFIA could be accessed, which locks in low interest rates over long periods. These loans (or loan guarantees) could be serviced by value capture mechanisms and a percentage of the operating revenue for the specified period of the loan. Federal funding vehicles such as the TIGER and FASTLANE discretionary grant programs would also be applicable.

## ATTRACTING INVESTMENT

The state government, in concert with local government, will implement an investment attraction strategy that dovetails into a larger, region-wide economic development policy aimed at fostering and augmenting centers of specialization and high value economic development. This program to attract investors will focus on specific sites and areas around the development (with particular focus on DEN) as well as on attracting investment into the development of the Hyperloop infrastructure itself. Establishing a special economic zone (SEZ) on a site near DEN will encourage supply chain integration, attract export oriented companies and encourage the relocation of companies seeking to tap into the Front Range's workforce, and multimodal system of freight movement. The SEZ will offer companies a reduction in import tariffs, export taxes and other incentives.

The largest single beneficiary of the Rocky Mountain Hyperloop will be DEN. In establishing the hub of the Hyperloop network near DEN, the timeline for the full development capacity of Aerotropolis will be accelerated by decades. The Hyperloop station and associated automated cargo facilities will be primary catalyst for making DEN the major multimodal transportation center for the Colorado. Efficiencies

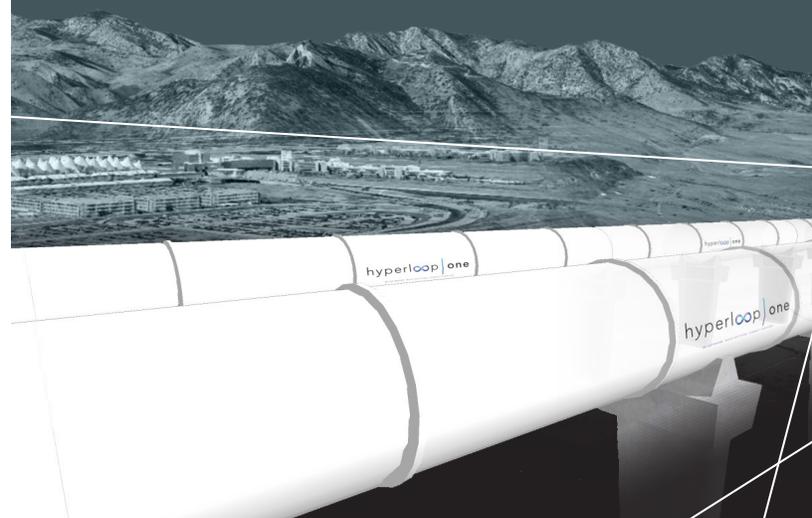
in cargo movement will also encourage supply chain integration in the region, particularly in regard to distribution, logistics, and assembly operations that will cluster around DEN. This in turn will drive the demand for expansion of the airport's capacity including the addition of runways to handle increased freight movements delivered by Hyperloop. Time sensitive freight operators, including e-tailers who offer two- to four-hour (or next day) delivery of their products, will benefit greatly from Hyperloop and the augmentation of DEN freight handling capabilities. Hyperloop will enable these companies to very quickly move large amounts of time sensitive freight to/from the airport to their distribution/fulfillment centers. Hyperloop will bring about efficiencies, and thus cost savings to their operations, and will incentivize them to invest in innovation in their own facilities and infrastructure, including developing systems of automation to help with the capture of efficiencies in the "last-mile" delivery of their products.

***The proposing team is excited to submit this proposal and welcomes the opportunity to broaden the network of partnerships and stakeholder engagement in the next steps to bring Hyperloop to Colorado!***



CLICK TO VISIT THE ROCKY MOUNTAIN HYPERLOOP GLOBAL CHALLENGE WEBSITE

<http://rockymountainhyperloop.aecomonline.net>



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